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Fourche Creek Urban
Runoff Project. Volume 2
Main Report

METROPLAN, Little Rock, AR

Prepared for

Environmental Protection Agency, Washington, DC

1983

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FOURCHE CREEK URBAN RUNOFF PROJECT

VOLUME II

MAIN REPORT

METROPLAN

A Council of Local Governments

1983

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The Little Rock, AK, WQM Plan identified urban runoff into Fourche Creek as the most significant nonpoint source water quality problem in the metropolitan area. Project objectives include, (1) clarifying the nature and extent of the problem; (2) analysis of the effectiveness of selected best management practices; (3) assessing cost effectiveness of BMP's, and (4) effects of application of BMP's throughout the Fourche Creek System.

BMP's evaluated included gabions, channel clearing with bank relocation and rip rap, and vegetation, and use of sodding with check dams to reduce slopes.

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Watersheds	Sedimentation	Urban planning	

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Streamflow	Water Quality	Urbanization
Stream pollution	Sediments	Land use
Rainfall	Sediment Transport	
Snowmelt	Suspended Solids	

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FOURCHE CREEK URBAN RUNOFF PROJECT

VOLUME II
MAIN REPORT

METROPLAN

A Council of Local Governments

1983

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I. INTRODUCTION

Prior to the beginning of the Fourche Creek Urban Runoff Project, preliminary assessments led investigators to assume that Little Rock urban runoff was contaminated with a variety of pollutants from a number of sources. These pollutants, it was believed, were denying full appreciation of the beneficial uses of the Fourche Creek main stem, numerous tributaries, and a bottoms area all of which were intimately associated with the city's extensive public and private parks system. Early assumptions about the nature of Fourche Creek system pollution are summarized below.

Exhibit 1

Summary of Previous Assessments
Fourche Creek Water Quality
(Columns Do Not Correlate)

Potential Pollutants

- Fecal Coliforms
- Heavy Metals
- Suspended Solids
- Dissolved Oxygen
- Biochemical Oxygen Demand
- Pesticides, Herbicides Fertilizers
- Acidity

Potential Sources

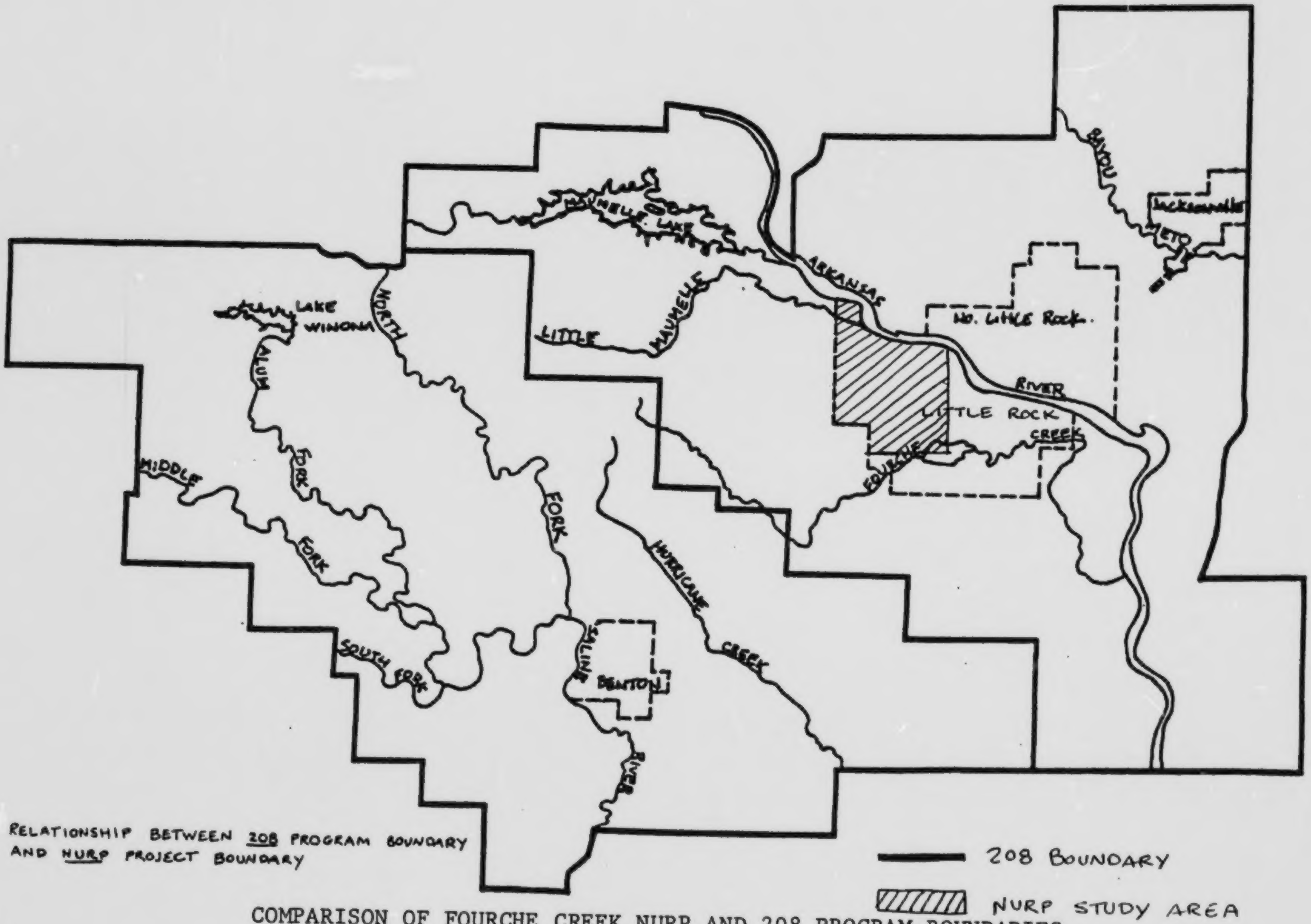
- Septic Tank Runoff
- Zoo Animal Wastes
- Street/Parking Lot Runoff
- Construction Sites
- Yards, Parks, Woods
- Ditches/Bare Areas
- Unstable Roadbeds

Beneficial Uses

- Fishing/Hunting
- Contact Recreation
- Boating
- Arboretum
- Hiking
- Wildlife Habitat
- Plant Preservation

Problem Background

Beyond efforts to evaluate urban stormwater impacts in terms of drainage and flood control, and to develop coordinated programs to lessen the severity of major storm events, several agencies have undertaken to assess the contribution of urban stormwater to the degradation of water quality in the Little Rock Fourche Creek watersheds. In 1974 preliminary sampling conducted by the Arkansas Department of Pollution Control and Ecology revealed that the water quality of the Fourche system is significantly degraded as it flows through the urban area. Accordingly, the Fourche system is officially classified as Water Quality Limited by the Department. More recent water quality sampling instituted in conjunction with the 208 Water Quality Management Planning Program for which Metroplan is the designated planning agency in the Little Rock Metropolitan Area, revealed more about both the quantitative and qualitative nature of the pollutants affecting the Fourche system (Exhibit 2). Since there are no major agricultural, mining, or other contributory activities associated with Fourche in the urban area, it is known that the bulk of the pollutants degrading its quality derive specifically from urban runoff. Indeed, the nature of the pollutants supports this fact. The Arkansas Department of Health has for some time worked to eradicate polluting leakage from package wastewater treatment plants effecting Fourche. Numerous violations in heavy metals standards, lead for example, were revealed in urban runoff by the


BAYOU
METO
Jacksonville
ARKANSAS
RIVER
No. Little Rock
LITTLE ROCK
FOURCHE
CREEK
MAUMELLE LAKE
LITTLE
MAUMELLE
LAKE
WINONA
NORTH
FORK
ALUM
FORK
MIDDLE
FORK
SOUTH FORK
HURRICANE
CREEK
SALINE
BENTON
RIVER
RELATIONSHIP BETWEEN 208 PROGRAM BOUNDARY
AND NURP PROJECT BOUNDARY
208 BOUNDARY
NURP STUDY AREA

COMPARISON OF FOURCHE CREEK NURP AND 208 PROGRAM BOUNDARIES

Exhibit 2

U.S. Geological Survey in another sampling program. Nonpoint contractors contributing to the development of the area's first 208 plan singled out urban stormwater runoff generated in associated watersheds as the major source of contaminants of the Fourche system. Additional analysis of nonpoint problems in the western metropolitan area and growth trends have led nonpoint contractors to conclude that new subdivision construction activities in the Fourche watersheds can be expected to contribute heavily to further degradation of water quality unless control measures are implemented.

The Fourche Creek Watershed is 48 per cent forest, 19.8 per cent agricultural, and 28.2 per cent urban. This is the largest ratio of urban to total land of any of the 208 study areas. In this instance, urban areas contribute the major portion of all pollutants. In 1977, urban areas contributed about 70 per cent of the total nutrient load (62 per cent BOD_5, 71 per cent TN, 75 per cent TP), and 36 per cent of the TSS load. This will increase to an average of 77 per cent of the 2,000 nutrient load (70 per cent BOD_5, 78 per cent TN, 82 per cent TP) and 44 per cent of the TSS (Exhibit 3). Agricultural land contributed an average of 18 per cent of the nutrient load and 46 per cent of the TSS load in 1977; this will decrease to 14 per cent and 40 per cent respectively in 2000. Forest lands contributed 14 per cent of the nutrient load in 1977 and which will decline to 8 per cent in 2000; for TSS these values are 18 per cent and 16 per cent respectively.

Fourche Creek is known to be significantly affected by storms under present conditions. This situation will continue. During

URBAN RUNOFF, FOURCHE CREEK BASIN
Exhibit 3

Actual 1977

WATERSHED NAME	TOTAL AREA (acres)	% URBAN	URBAN AREA (acres)	FRACTION URBAN IMPERV.	RUNOFF-TO-RAINFALL RATIO, R_v	ANNUAL RUNOFF (10^6 ft^3/yr)	ANNUAL URBAN POLLUTANT LOADS			
							BOD$_5$ (lb/yr)	TN (lb/yr)	TP (lb/yr)	SEDIMENT (10^3 lb/yr)
Fourche Creek 1	3,884	42	1,627	0.439	0.38	111	62,700	27,700	2,070	1,245
Fourche Creek 2	4,812	49	2,345	0.494	0.40	168	94,200	41,900	3,140	1,884
Fourche Creek 3	5,822	76	4,447	0.452	0.39	308	172,900	76,800	5,760	3,454
Fourche Creek 4	10,184	27	2,793	0.372	0.36	182	102,000	45,400	3,400	2,041
Fourche Creek 5	14,830	26	3,920	0.386	0.37	258	144,600	64,300	4,820	2,893
Fourche Creek 6	10,992	15	1,703	0.401	0.37	113	61,200	28,200	2,110	1,267
Fourche Creek 7	20,896	11	2,242	0.392	0.37	148	83,100	36,900	2,770	1,660
Little Fourche Creek	16,758	25	4,237	0.511	0.41	312	175,100	77,800	5,830	3,499
Rock Creek 1	7,300	59	4,329	0.444	0.38	298	167,400	74,300	5,570	3,342
Rock Creek 2	10,000	22	2,153	0.284	0.34	130	72,800	32,400	2,430	1,458
TOTAL	105,478	28	29,796	0.427	0.38	2,028	1,136,000	505,700	37,900	22,743

Projected 1983

WATERSHED NAME	TOTAL AREA (acres)	% URBAN	URBAN AREA (acres)	FRACTION URBAN IMPERV.	RUNOFF-TO-RAINFALL RATIO, R_v	ANNUAL RUNOFF (10^6 ft^3/yr)	ANNUAL URBAN POLLUTANT LOADS			
							BOD$_5$ (lb/yr)	TN (lb/yr)	TP (lb/yr)	SEDIMENT (10^3 lb/yr)
Fourche Creek 1	3,884	46	1,797	0.413	0.37	121	68,100	30,200	2,260	1,357
Fourche Creek 2	4,812	49	2,370	0.495	0.40	170	95,100	42,400	3,180	1,906
Fourche Creek 3	5,822	78	4,522	0.452	0.39	314	175,900	78,200	5,870	3,521
Fourche Creek 4	10,184	29	2,967	0.377	0.36	194	108,700	48,300	3,630	2,176
Fourche Creek 5	14,830	28	4,203	0.391	0.37	278	155,700	69,300	5,200	3,117
Fourche Creek 6	10,992	17	1,842	0.403	0.37	123	68,900	30,700	2,300	1,379
Fourche Creek 7	20,896	12	2,490	0.408	0.37	167	93,400	41,600	3,120	1,873
Little Fourche Creek	16,758	27	4,564	0.510	0.41	336	188,100	83,700	6,280	3,769
Rock Creek 1	7,300	65	4,753	0.448	0.38	329	184,600	82,000	6,150	3,689
Rock Creek 2	10,000	23	2,260	0.289	0.34	137	77,000	34,100	2,560	1,536
TOTAL	105,478	30	31,768	0.431	0.38	2,169	1,215,500	540,500	40,550	24,322

Projected 2000

WATERSHED NAME	TOTAL AREA (acres)	% URBAN	URBAN AREA (acres)	FRACTION URBAN IMPERV.	RUNOFF-TO-RAINFALL RATIO, R_v	ANNUAL RUNOFF (10^6 ft^3/yr)	ANNUAL URBAN POLLUTANT LOADS			
							BOD$_5$ (lb/yr)	TN (lb/yr)	TP (lb/yr)	SEDIMENT (10^3 lb/yr)
Fourche Creek 1	3,884	48	1,877	0.429	0.38	128	71,700	31,900	2,390	1,435
Fourche Creek 2	4,812	50	2,392	0.498	0.40	172	96,500	42,900	3,210	1,929
Fourche Creek 3	5,822	79	4,579	0.554	0.45	370	207,400	92,200	6,910	4,149
Fourche Creek 4	10,184	37	3,776	0.397	0.37	251	140,700	62,500	4,690	2,815
Fourche Creek 5	14,830	37	5,426	0.405	0.37	363	203,800	90,500	6,780	4,071
Fourche Creek 6	10,992	22	2,408	0.420	0.38	163	91,100	40,600	3,050	1,828
Fourche Creek 7	20,896	16	3,370	0.430	0.38	230	128,600	57,300	4,300	2,579
Little Fourche Creek	16,758	34	5,742	0.506	0.41	419	235,200	104,400	7,830	4,699
Rock Creek 1	7,300	72	5,275	0.451	0.39	366	205,200	91,200	6,840	4,204
Rock Creek 2	10,000	28	2,797	0.325	0.35	175	98,100	43,600	3,270	1,962
TOTAL	105,478	36	37,642	0.464	0.39	2,637	1,478,300	657,100	49,270	29,571

low flow and mean summer flow, both large and average storms produce violations of the 5 mg/l dissolved oxygen (DO) standard. A large storm occurring during mean annual flow will produce a violation. Further, the oxygen depression can be severe. During low flows, the range of DO varies from 1.2 mg/l to about 6.3 mg/l, over 5 mg/l. Stormwater flows may produce DO violations of consequence in Fourche Creek.

This analysis does not include the effects of background deficit or oxygen demand from existing organic deposits which may be resuspended during high flow. The lower Fourche Creek basin has extensive swampy areas which collect debris and natural organics. It is likely that the actual dissolved oxygen levels in these systems are significantly lower than those predicted because of these additional organics. It is reasonable to assume that as much as one additional mg/l of deficit could be caused by these organics.

The initial 208 Plan Management Report designated the control of urban runoff in Fourche Creek as the first priority item to be addressed in the 208 Continuing Planning Program. Accordingly, the management report recommended several agencies as nonpoint management agencies to coordinate control programs within the Fourche Creek urban watersheds to improve water quality. These agencies are the City of Little Rock, Pulaski County, the Arkansas Health Department, the Pulaski Conservation District, the Arkansas Forestry Commission and the Arkansas Department of Pollution Control and Ecology. Each accepted the responsibilities which the 208 program required of management agencies. Furthermore, all participated in the Fourche

Creek Urban Runoff Project with Little Rock contributing necessary local matching funds. The Fourche Creek Urban Runoff Project was the first step in the coordination of these agencies with the goal of implementing urban runoff improvements in the Little Rock Metropolitan Area.

Working with Metroplan and the Arkansas Department of Pollution Control and Ecology, the management agencies evaluated Best Management Practices to improve water quality in the Fourche System. Previously, several of these BMP's were being applied without a coordinated plan, and without any realistic determination of cost effectiveness. The Fourche Creek Urban Runoff Project provided the means for the necessary evaluation of BMP's to select those which, when applied logically and uniformly throughout the Fourche Creek System, would result in water quality improvement and stream beneficial use enhancement at an acceptable cost.

Urban stormwater typically produces the major portion of nonpoint pollution in all but the most rural areas. This is because urban areas have a high ratio of imperviousness (more of the rainfall becomes runoff) and because the runoff usually carries a high concentration of pollutants (produced by city living). Urban stormwater management is, therefore, of high priority.

In projecting probable urban stormwater impacts on area streams estimated concentrations for BOD_5/DO, TN, TP, and TSS were determined by using national averages and adjusting them heavily, based on data collected by local sampling programs, specifically the USGS and a special program by the University of Arkansas at Little Rock (UALR).

The table below shows national data, local data, and the numbers actually used in calculations:

Exhibit 4

Urban Runoff Values

	National		Local Composite		
Parameter	Avg.	Range	Avg.	Range	Selected Value
BOD_5 (mg/l)	27	2-50	9	4-30	9
TN (mg/l)	2.3	1-4	4.0	1.4-17.1	4.0
TP (mg/l)	0.5	0.1-1.0	0.3	0.08-1.4	0.3
TSS (mg/l)	608	50-1,200	180	49-863	180

Clearly, the local values fall within national ranges of values and are therefore used.

Using these values annual, seasonal, and summer storm loads were calculated for each of the 4 parameters in each of the 3 study years for each of the 53 segments in the original 208 study area. Exhibit 5 summarizes the annual urban load data for Fourche Creek Watersheds. Fourche Creek system single summer storm loads and annual loads were calculated and are summarized in Exhibit 6.

General conclusions reached were:

(1) For all parameters, annual urban stormwater loads increase for each study year. Thus, urban stormwater becomes increasingly important with time in the Fourche Creek system.

Exhibit 5

Fourche Creek

Estimated Annual Urban Pollutant Loads (lbs.)
By Year, and Parameter

	Year	BOD_5	TN	TP	TSS $(x10^3)$
Fourche Creek	1977	1,136,000	505,700	37,900	22,743
	1983	1,215,500	540,500	40,550	24,322
	2000	1,478,300	657,100	49,270	29,571

(2) For all parameters and for all years, the Fourche Creek system produce the highest in annual Little Rock metropolitan urban stormwater loads after the Arkansas River system.

(3) For all parameters in the Fourche Creek system, and for all Presentation Areas, single summer storm urban stormwater loads will increase each year. Thus, individual storms covering urban areas will be become increasingly important with time. Further urbanization will increasingly effect water quality.

(4) For all parameters and for all years, the Fourche Creek system produces the highest loads during individual summer storms in the Little Rock Metropolitan Area except for the Arkansas River system.

Thus, the 208 plan concluded urban growth will have an increasingly detrimental effect on water quality, and cited management of Fourche Creek urban runoff as the highest priority for an implementation program.

Metal analyses of Fourche Creek water were run during four separate programs: the UALR stormwater data taken for this study;

USGS stormwater data taken for this study; the UALR Fourche Creek Study; and Arkansas Department of Pollution Control and Ecology (ADPC&E) data. All are related to urban runoff.

Exhibit 6

Fourche Creek

Estimated Summer Storm Urban Pollutant Loads By Year, and Parameter

	Year	BOD$_5$ (#/Storm)	TKN (#/Storm)	F. Coli 10^{12} Org/storm)
Fourche	1977	8,476	3,305	30.9
	1983	9,072	3,528	33.0
	2000	11,031	4,290	40.1

The UALR stormwater study showed that seasonal low flow values of arsenic, cadmium, copper, mercury, lead, and zinc were all within water supply standards. Several samples taken during storms showed cadmium, mercury, and lead to be above standards; three stations had chromium violations during low flow, high flow, or both; and iron violated the standards under both low flow and high flows at all but one station. Arsenic and zinc are chiefly the result of natural background, but all other metals are from urban stormwater.

The USGS study used in researching this project showed that high flow samples for companion streams, the Saline River, Hurricane Creek, Arkansas River, Fourche Creek, and Bayou Meto, all had iron and manganese above recommended levels. Arsenic, cadmium, chromium, cobalt, copper, lead, mercury, nickel, and zinc levels were all within standards.

The UALR Fourche Creek study showed no violations, but unfortunately only soluble metal fractions were analyzed.

Levels of Assessment During Original 208 Study

When studying a phenomenon as involved as stormwater runoff, the approach was to select techniques (1) whose complexity matches the available data, and (2) which build upon previous analyses. Stretching beyond these limits could lead to questionable results. Analyzing at achievable levels provided insights which are reliable and which direct further, more refined analyses. In addition, the areal extent and length of time over which water quality impacts are expected to occur were considered.

Exhibit 7 illustrates various levels of assessment which were employed in defining transient stormwater conditions. This exhibit represents the spread from relatively simple average yearly loading calculations to a detailed representation of stormwater. The levels of assessment are:

Level 1. Average yearly storm load
Level 2. Actual event distribution
Level 3. Variation within events

Because 208 was the first nonpoint study in this area, a Level 1 assessment and a modified Level 2 assessment were carried out. This eliminated certain conditions from further analysis and allowed problems to be pinpointed for additional study, the Fourche Creek NURP Project.

Level 1 characterized stormwater loadings as total seasonal or annual loads, M_o, with no further description of the number of events, load per event, or distribution of load within event. M_o was calculated by determining the total load (mass) from storms during the period. Comparison of the total annual stormwater load with the annual point source loads gave a quick appraisal of relative long-term impacts. This type of comparison is particularly useful when a downstream reservoir exists which retains the pollution load for an extended period of time. Effects studied at this level included eutrophication caused by high levels of nutrients in runoff and the long-term buildup of toxic substances in the receiving water body. A Level 1 analysis is particularly appropriate for comparisons between annual nonpoint loads and annual point source loads.

A high level of confidence in the value of M_o required the monitoring of all storm loads over a period of several years; this was impractical within the 208 planning time frame. Therefore, a Level 1 analysis relied initially on estimates of loads extrapolated from other studies or projected from data secured from limited areas and over limited time periods. In this type of analysis annual mean concentrations are often used with estimated annual or seasonal runoff to produce estimates of total annual or seasonal loads.

The types of information used in this Level 1 assessment included average annual rainfall, generalized land use distribution by watershed, average long-term runoff potential, and average stormwater pollutant concentrations from storms during different seasons. The seasonal distribution of the loads were estimated based on the seasonal distribution of rainfall.

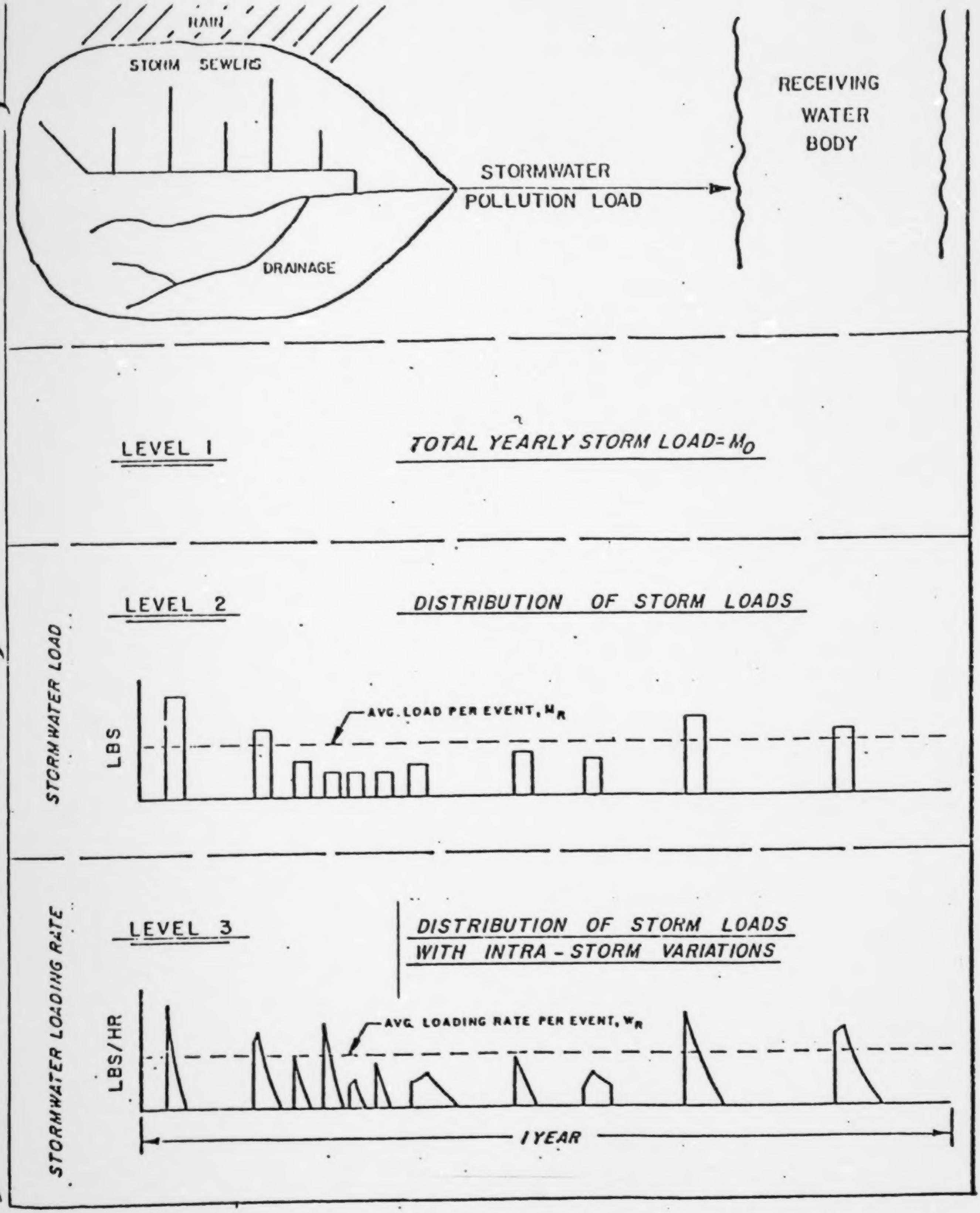

RAIN
STORM SEWERS
DRAINAGE
STORMWATER
POLLUTION LOAD
RECEIVING
WATER
BODY
LEVEL 1
TOTAL YEARLY STORM LOAD= M_O
LEVEL 2
DISTRIBUTION OF STORM LOADS
STORMWATER LOAD
LBS
AVG. LOAD PER EVENT, M_R
LEVEL 3
DISTRIBUTION OF STORM LOADS
WITH INTRA - STORM VARIATIONS
STORMWATER LOADING RATE
LBS/HR
AVG. LOADING RATE PER EVENT, W_R
1 YEAR

EXHIBIT 7
VARIOUS LEVELS OF DETAIL IN
STORMWATER LOAD CHARACTERIZATION

Level 2 analyses included a more thorough investigation of the distribution of the pollution loads among storms. The average number of yearly events were determined. The average single storm volume on an annual, seasonal, or monthly basis was used to estimate the mean stormwater loading, M_R, for a single storm during the chosen interval, as well as the frequency with which various magnitudes of loading can be expected. A statistical method specifically designed to assess the magnitude and variability of storm loads was used. This led to an assessment of the pollution reduction abilities of various control strategies over the range of storm events. This approach is particularly useful for impacts associated with individual storms, such as elevated BOD, TSS, and bacteria levels.

To move to this level, detailed storm characteristic variations were needed. In addition, seasonal variations in runoff potential and seasonal variation in pollutants available for flushing were incorporated in to the load generation procedure.

For the original 208, some of this seasonal information was not readily available; however, the seasonal distribution of rainfall and the return frequency of storm volumes was incorporated into the Level 2 analysis.

Level 3 analyses attempt to reproduce stormwater loading patterns in great detail. The variation in loading rate is determined throughout a specific event, accounting for "first flush" effects and the effects of drainage basin characteristics on the runoff hydrograph. With this information, the loading rate during the event can be calculated as well as the average loading rate, W_R.

A Level 3 analysis is generally performed only after refined Level 1 and 2 analyses have shown it to be warranted. It is used to investigate definite problems at specific locations; to provide detailed information for the design of specific structures; or to simulate loading patterns from specific storm events with known loading rates and hydrographs. The analysis starts with an extensive survey of a number of individual storms to provide detailed information on hydrologic characteristics. It also requires a similarly detailed survey of the receiving water body to determine the physical stream characteristics and variations during transient flow conditions. Consequently, a Level 3 approach is superior to a Level 1 or Level 2 approach only if a highly detailed investigation is warranted and if sufficient data are available for its implementation.

Initiation of the NURP Study

It was clear from the initial 208 planning process that the Fourche Creek problems were, in general, well understood. There were several reports which detailed the types and sources of pollutants. Equally clear, from an evaluation of the BMP's available for controlling these pollutants, was that many of these BMP's had been applied already in the project area.

For the Fourche project, Metroplan utilized the first year to perform a detailed assessment of the water quality within the creek, building upon the information developed by the 208 nonpoint planning effort. Also during this period Metroplan selected BMP's for evaluation. A detailed program design was prepared during the first year to effectively utilize the remaining resources. General categories in which BMP's were evaluated included the following:

1. Improved Urban Drainage: The City of Little Rock's Departments of Parks and Recreation and Public Works participated in work on the major Fourche Creek tributaries of Rock Creek, Coleman Creek, and Grassy Flat Creek to improve flow and stabilize eroding banks.

2. Effectiveness of Parks and Natural Areas As Stream Buffers for Improving Water Quality: The city maintains four major parks within the Fourche Creek Urban Runoff Project area. In addition, the University of Arkansas at Little Rock owns undeveloped property through which Coleman Creek, an important Fourche Creek tributary, flows. Previous 208 studies in the area suggested an improvement in water quality as a result of flow through these park areas. This was especially true of Boyle Park in the Rock Creek basin. The effects of these buffer areas on water quality were evaluated as BMP's to be applied elsewhere. This was particularly significant since local and federal officials are proposing to expand the use of natural areas within the project boundaries.

Throughout the project, Metroplan and the participating management agencies evaluated the coordinated approach to solving Fouche Creek water quality problems. Metroplan managed the project and the coordination and management responsibilities were evaluated against standards of Fourche Creek water quality, and of public support for the project recommendations.

The City of Little Rock, The Pulaski Conservation District, Pulaski County, the Arkansas Health Department, the Arkansas Department of Pollution Control and Ecology, the Arkansas Forestry Commission, and Metroplan were the management and regulatory agencies recommended in the initial 208 plan for controlling non-point runoff in the Fourche Creek watersheds. All agreed to cooperate in the Fourche Urban Runoff Project, and the city provided a portion of the local matching share of the funding. The remainder of the local share included a substantial contribution from the University of Arkansas at Little Rock which was responsible for water sampling and analysis as a part of the University's long term urban watersheds studies. These agencies integrated their existing programs with some modifications and additions and a new emphasis on water quality goals. This was deemed to be the best approach for solving Fourche Creek water quality problems. The evaluation of BMP's to achieve the most cost effective results was the first step in this program.

Project Assessment

The results of the Fourche Creek Urban Runoff Project were measured in several ways. First, an absolute improvement in Fourche water quality was taken as indication that the Fourche Urban Runoff Project succeeded (see Exhibits 33, 36 and 44 below). Second, public and local officials acceptance of recommended programs and their cooperation demonstrated Metroplan's ability to coordinate the project.

Selected watersheds in the Fourche Urban System were monitored to determine which BMP's were most cost effective in reducing the identified water quality problems. The University of Arkansas at

Little Rock, which had the task of gathering much of the basic runoff water quality data during the initial phase of the 208 planning process, continued to perform monitoring and analysis tasks in the Fourche Creek Urban Runoff Project. (Results of dry weather and storm event analysis are presented in full in Volume II of this report, The Data Report.)

Impact and Benefits

Among the community benefits expected from the Fourche Creek Urban Runoff Project were the following:

(1) Improved parks and recreational systems' improvements in the quality of recreational life in several disadvantaged and minority neighborhoods.

(2) Improvement of Fourche Creek waters to meet a variety of water quality standards, including those for public health.

(3) Reduction of health hazards from contact with Fourche Creek waters and from fishing in the creek system.

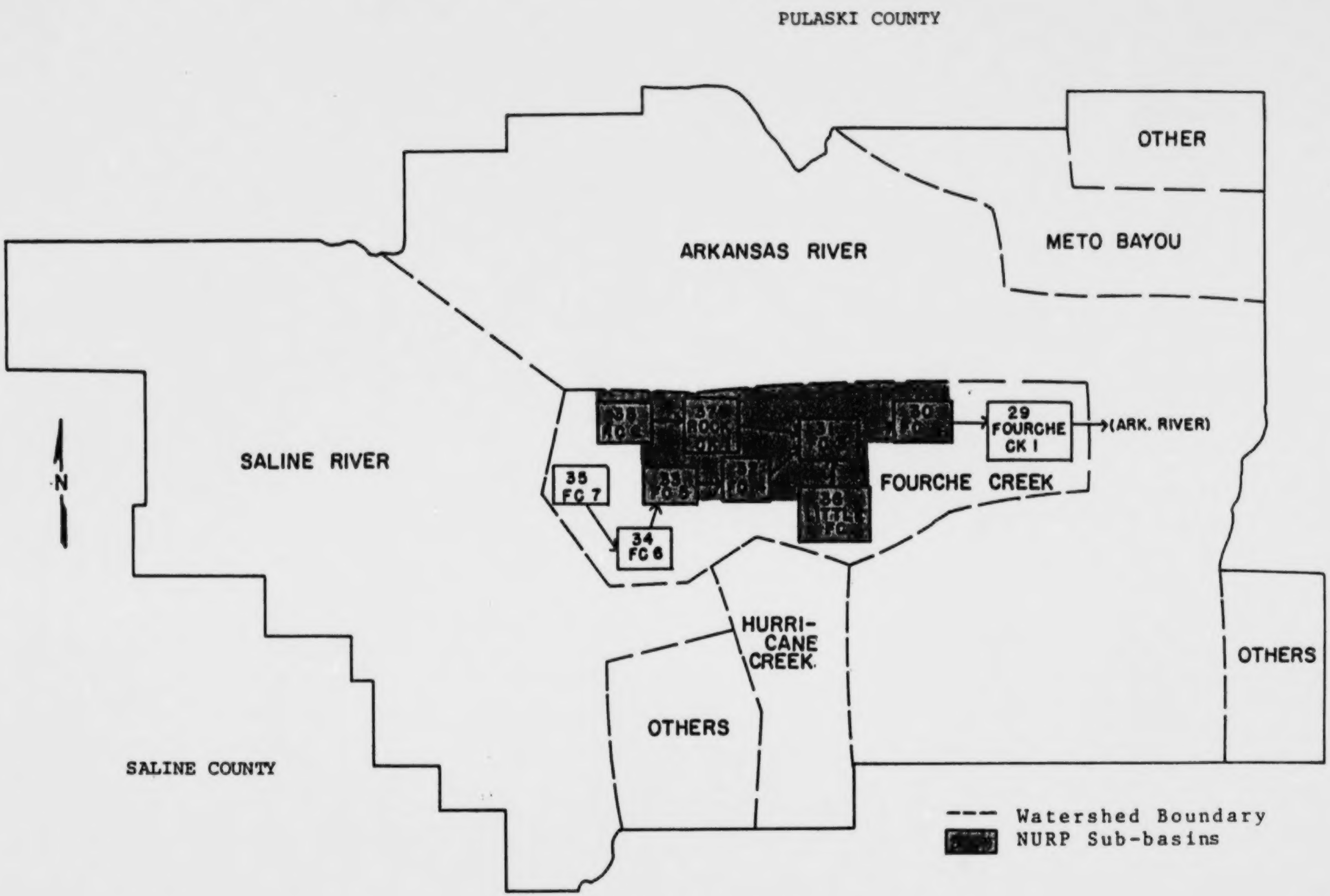
(4) Maximum utilization of public monies dedicated to improving the Fourche Creek water quality situation.

II. DESCRIPTION OF PROJECT AREA

Fourche Creek Watersheds

The Fourche Creek basin is located south of the Arkansas River and encloses most of the urban area of Little Rock, Arkansas. Fourche Creek, which originates in the undeveloped portions of western Pulaski County, generally follows a west to easterly movement passing through the southern portions of the Little Rock Metropolitan Area (Exhibit 8). The land use patterns along the several tributary streams within the basin exhibit a variety of character from the natural landscapes of the undeveloped western edge to the intense commercial activities of urban Little Rock (Exhibit 9). Moving up stream from the Arkansas River, the geographic character of the basin exhibits a marked change from the alluvial plains southeast of Little Rock to rolling hills and steep slopes which develop within Little Rock and the western portion of Pulaski County (Exhibit 10).

The Southwestern area of the basin contains Otter, Owen, Brodie, and McHenry Creeks which serve as principal tributaries within the basin. With the exception of Otter Creek, all of these basin tributaries originate in the undeveloped woodlands of western Pulaski County and move eastward across the basin. Land use associated with this southwestern area is a mixture of woodland forests, pasture lands, and low density residential development. Heavily forested in its western reaches, Fourche Creek lands quickly change to mixed pasture as it approaches the urban fringe of Little Rock. Fourche Creek continues eastward to


PULASKI COUNTY
OTHER
METO BAYOU
ARKANSAS RIVER
29 FOURCHE CK I
(ARK. RIVER)
30 FC
FOURCHE CREEK
35 FC 7
34 FC 6
HURRI- CANE CREEK.
OTHERS
OTHERS
SALINE RIVER
SALINE COUNTY
N
Watershed Boundary
NURP Sub-basins

PULASKI-SALINE COUNTIES WATERSHEDS

Exhibit 8

PROJECT AR

FAST TRAK FIXED SITE DATA

Sub-Basin	Station Code	Total Area (Acres)	Residential Land Use (Per Cent)	Commercial Land Use (Per Cent)	Industrial Land Use (Per Cent)	Open Land Use (Per Cent)	Other Land Use (Per Cent)	Population Density (/Acre)	Slope (Ft/Mile)	Impervious Area (Per Cent)
11	1020	5187.2	8.4	0.7	2.2	.06	88.7	.10	94.28	32.8
12	1040	4816.08	48.9	9.8	4.0	2.45	34.8	4.75	26.83	50.7
13	-	712.00	35.6	27.2	3.1	7.81	26.2	3.92	15.62	53.9
21	1010	2460.8	61.6	10.4	4.7	8.40	14.8	5.22	72.62	53.8
22	-	669.4	51.9	8.0	0	9.60	30.4	5.25	35.90	47.5
31	1090	2123.7	52.2	29.6	1.7	9.50	7.0	4.83	86.81	59.1
32	-	130.3	5.2	29.9	14.7	0	50.2	.68	17.73	66.0

Subbasin Codes

Subbasin 11 - Rock Creek Subbasin west of Sta. 1020
12 - Rock Creek Subbasin west of Sta. 1040
13 - Rock Creek Subbasin west of mouth to Sta. 1040
21 - Grassy Flat Creek Subbasin west of Sta. 1010
22 - Grassy Flat Creek Subbasin west of mouth to Sta. 1010
31 - Coleman Creek Subbasin north of Sta. 1090
32 - Coleman Creek Subbasin mouth to Sta. 1090
99 - Basins - outside NURP study area

NURP SUB-BASIN LAND USES

Exhibit 9

Exhibit 10

FOURCHE CREEK BASIN SOIL TYPES

Code	Soil Type
1	Ao - Amy silt loam, frequently flooded
2	Au - Amy - Urban land complex
3	CaC - Carnasaw Gravelly silt loam, 3 to 8 per cent slopes
4	CaD - Carnasaw gravelly silt loam 8 to 12 per cent slopes
5	CbC - Carnasaw - Urban land complex, 3 to 8 per cent slopes
6	CbD - Carnasaw - Urban land complex, 8 to 12 per cent slopes
7	CMC - Carnasaw - Mountainburg association, undulating
8	CMF - Carnasaw - Mountainburg association, steep
9	LdB - Leadvale - Urban land complex, 1 to 3 per cent slopes
10	LeB - Leadvale silt loam, 1 to 3 per cent slopes
11	Re - Rexor silt loam, frequently flooded
12	Rf - Rexor - Urban land complex, frequently flooded
13	SgB - Sallisaw gravelly silt loam, 1 to 3 per cent slopes
14	SgC - Sallisaw gravelly silt loam, 3 to 8 per cent slopes
15	ShC - Sallisaw - Urban land complex, 3 to 8 per cent slopes
16	SKC - Sallisaw - Leadvale association - undulating
17	UT - Urban Land

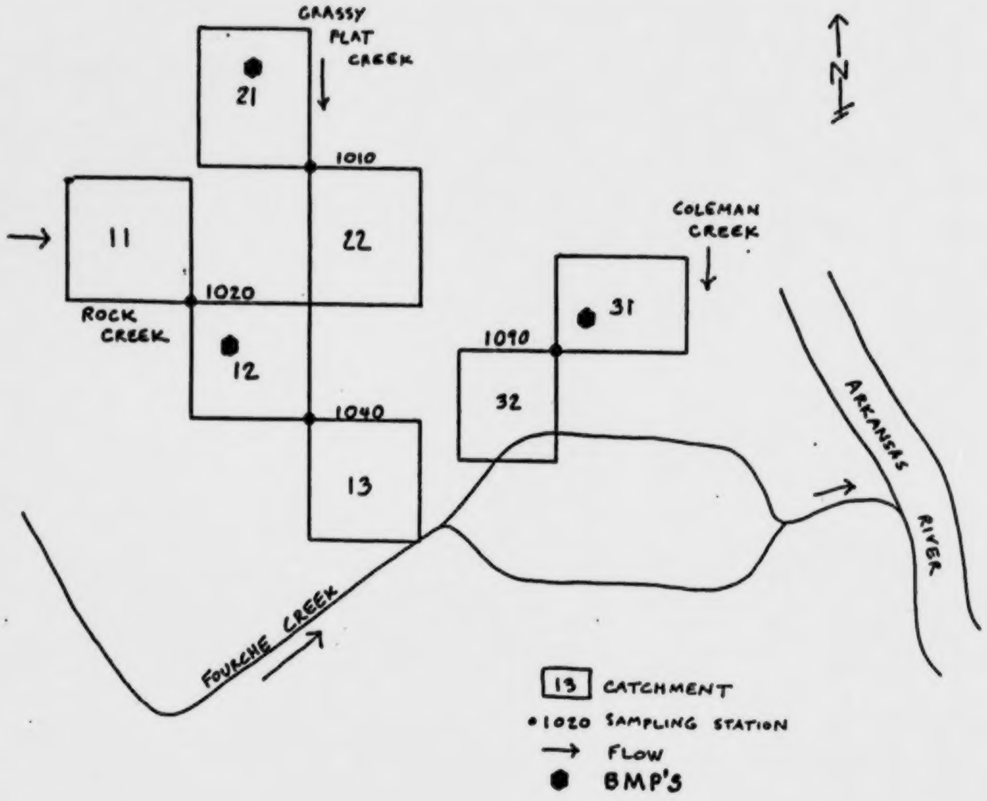
Hindman Park, which marks the beginning of the primary urban development of western Little Rock. Beyond Hindman Park, Fourche Creek approaches University Avenue where it meets the major tributary, Rock Creek. This portion of Fourche Creek is characterized by intense urban activity.

Rock Creek is the major tributary of Fourche Creek within the urban area of Little Rock, originating in the northwestern portion of Pulaski County. Its character is similar to other tributaries of the Fourche basin with origins in the more steeply sloped woodlands west of the Little Rock urban area. Rock Creek enters Little Rock's fastest developing residential lands and is characterized by high stream velocities and incidents of flash flooding. The greater elevation and visual relief features of the upper reaches of Rock Creek, where a variety of visual landscapes offer pleasing contrasts, have resulted in significant residential growth. Rock Creek enters the urban area in the vicinity of the I-430/I-630 interchange on the western border of Little Rock and is surrounded by primarily low to medium density residential development.

Coleman Creek drains a portion of west-central Little Rock before entering Fourche Creek near University Avenue. The land use in this watershed is mixed commercial and residential.

Grassy Flat Creek originates within the northwestern urban area of Little Rock and flows into Rock Creek. Rock Creek continues southeastward through residential and light commercial development. After Rock Creek enters Kanis Park and subsequently crosses 12th Street, it enters Boyle Park, perhaps the most significant city park of the urban area. Rock Creek as it moves through Boyle Park offers area residents a recreational experience unique to the urban area.

As Rock Creek joins Fourche Creek immediately east of University Avenue, the nature of the adjacent land use undergoes a marked decrease in residential and commercial densities. Fourche Creek is once again surrounded by pasture and woodlands in the vicinity of the private Worth James airport. Fourche Creek divides in this segment forming its own northern and southern borders for the massive bayou which exists immediately south of the Little Rock area. This largely undisturbed bayou or "Fourche Bottoms" floodplain forms a natural flood storage area which constitutes a barrier to development and its esthetic beauty remains largely inaccessible to public use. The Fourche Bottoms are characterized by massive cypress and hardwood forests surrounded by typical wetland vegetation, where flooding is characterized by slowly rising pools which remain for considerable periods of time. Long considered a potential recreational and natural resource, Fourche Bayou remains a uniquely undisturbed resource within the metropolitan area. Downstream of these bottom lands Fourche Creek is crossed by the I-30 Highway in the vicinity of the East Belt Freeway. The stream continues eastward along the southern border of the Adams Field Airport and then northerly to its final confluence with the Arkansas River.


GRASSY
PLAT
CREEK
21
1010
11
22
ROCK
CREEK
1020
12
1040
13
COLEMAN
CREEK
31
1090
32
N
ARKANSAS
RIVER
FOURCHE CREEK
13 CATCHMENT
•1020 SAMPLING STATION
→ FLOW
● BMP'S

POPULATION ESTIMATES IN NURP BASINS AND SUB-BASINS-1980

Rock Creek

Sub-basin		11	537
"	"	12	22,875
"	"	13	2,789
		Total	26,201

Grassy Flat

Sub-basin		21	12,840
"	"	22	3,516
"	"	Total	16,356

Coleman

Sub-basin		31	10,624
"	"	32	89
		Total	10,713

GRAND TOTAL NURP BASINS--53,270

NURP Project Sub-basins, BMP's, and Populations

Exhibit 11

Population

Draining ninety per cent of the city, the Fourche Creek system effects a number of different types of neighborhoods (Exhibit 11). Most significantly in terms of benefits to citizens, the main stem of Fourche Creek and the major tributaries of Rock Creek and Coleman Creek flow through neighborhoods composed primarily of lower income and minority groups. This is especially true of the census tracts which surround the proposed Fourche Bottoms Public Use Area (1,750 acres) in the south central portion of the city. These census tracts average more than sixty-five per cent Black in racial composition. In short those expected to directly benefit most from an improvement in water quality in the Fourche Creek system are the disadvantaged and minority citizens rather than more affluent citizens inhabiting the city's western fringe.

Rainfall/Runoff Characteristics

To study nonpoint pollution logically, it is necessary to first analyze the rainfall, then the associated runoff, and finally the pollution associated with the runoff. These are physically complex, interrelated phenomena. In this project, the rainfall and runoff characteristics were studied statistically.

There were enough data to separate rain patterns into four seasons. Emphasis was placed on the summer season because that is normally the time when water quality is at its worse.

Rainfall Analysis

The National Weather Service rain gauge (#03 4248) best represents area rainfall characteristics. Until December 1975, this station was located at Adams Field in eastern Little Rock. It is now located at the North Little Rock Airport on Remount Road, north of the Fourche Creek basin. Computerized hourly rainfall data are available for the 27 years from 1949 to 1975.

The intensity, volume, duration, and time between storms for each of these events were calculated, grouped by years, and the means and standard deviations calculated. Annual volumes range widely, from 28.3 inches in 1963 to 74.4 inches in 1973. The average annual volume was 49.6 inches; this number was used to generate annual stormwater loads. The standard deviation was 10.0 inches assuming the total annual volumes were normally distributed, 68 per cent of all years had volumes between 39.6 and 59.6 inches. Seventy per cent actually fall within this range. The mean storm volume during a given year varies from 0.32 in/storm in 1963 to 0.56 in 1968.

Grouping storms by month indicated monthly and seasonal trends. There was a seasonal trend in intensity and duration, the higher intensity storms occurred in the summer, and the shorter storms occurred during mid-summer. These two trends indicated that shorter but more intense storms were prevalent during the mid-summer, and winter storms tended to be longer and less intense. The total volumes of the storms varied seasonally also, with pronounced peaks in the spring and late fall. The time between storms was greater in October and November than for all other months.

Using the expected number of storms per month, the annual summer (June through August), and non-summer weighted parameter averages were determined for both mean and standard deviations. The total expected number of annual storms was calculated to be 115. Storms occurred on the average every 76 hours and lasted 5.38 hours. The average intensity was 0.09 in/hr. and average storm rainfall was 0.43 in/storm.

Twenty-nine storms can be expected during the summer, the weighted average time between storms was 77 hours, and storms lasted 3.09 hours. The average rainfally intensity was 0.11 in/hr. and the average total rainfall volume was 0.37 in/storm. This mean summer storm volume of 0.37 inches was used to generate mean summer storm loads.

Of the 49.6 inches of rain falling annually, 10.7 inches can be expected during the summer months (June through August), 11.3 inches during the fall (September through November), 12.3 during the winter (December through February), and 15.3 during the spring (March through May). This proportioning of total annual rainfall volume by season (21, 23, 25, and 31 per cent) was used to prorate total annual loads. Exhibits 2 and 3 display these and other characteristics.

Fundamental to the analysis of stormwater loadings was the determination of the volume of rainfall available to become runoff. Therefore, this parameter was further analyzed and the results are shown in Exhibit 4. This exhibit shows that approximately 97 per cent of the storms have a rainfall volume with a return period of one year or less. Thus, a very wide variety of storms can be expected in any given year.

In addition, 70 per cent of the storms had volumes less than the mean of 0.43 in/storm, indicating the preponderance of storms with relatively small volumes. This was also an indication that single storm volumes were not normally distributed. Detailed statistical analysis revealed that they closely follow a gamma distribution. Gamma distributions were used subsequently to develop the distribution of stormwater loadings.

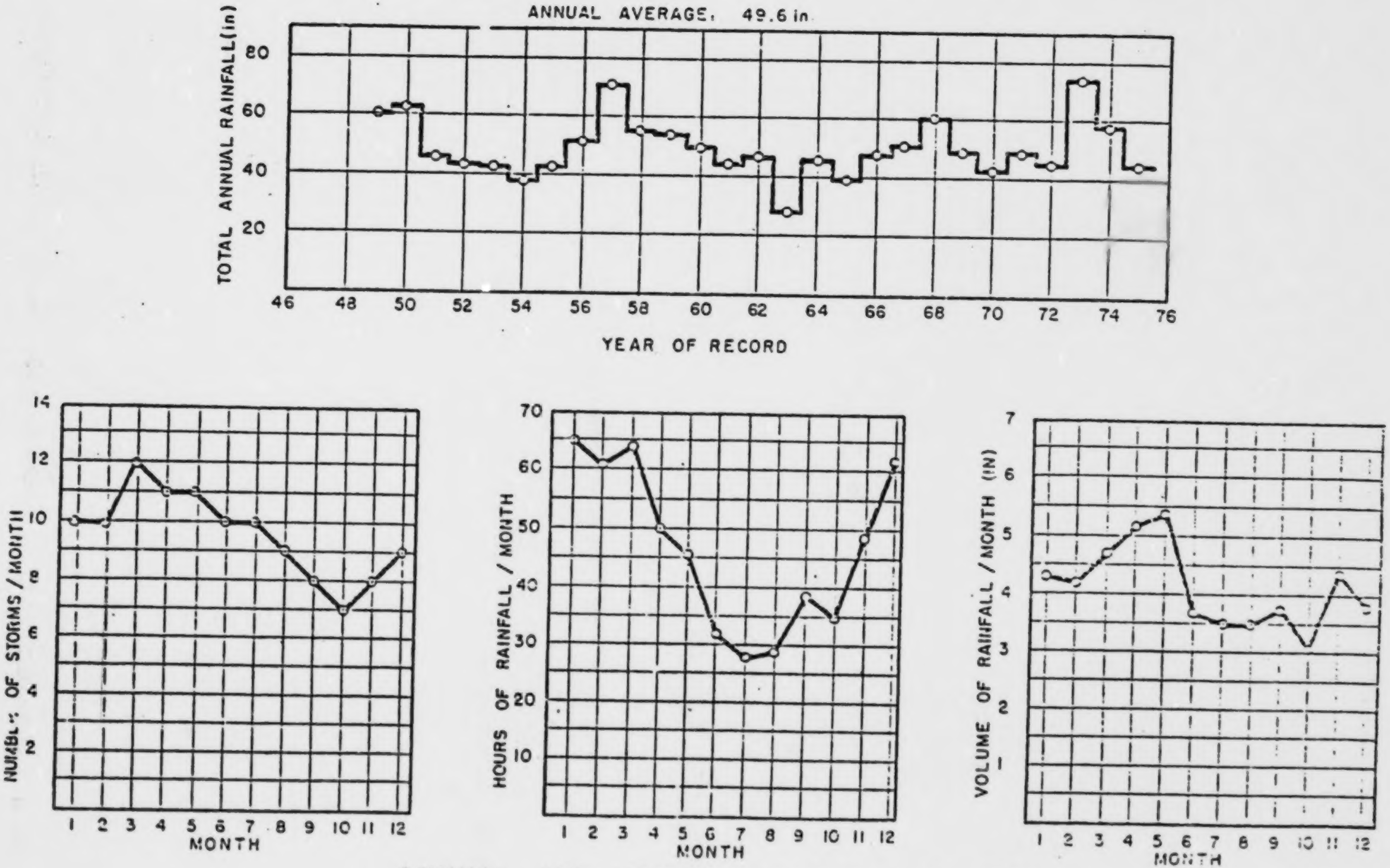
NWS Station: #03 4248

PERIOD OF RECORD: 1949-1975

Month	Duration (Hrs.)		Intensity (In/Hr.)		Volume/Storm (In.)		Time Between Storms (Hrs.)			Number of Storms
	Average	Std. Dev.	Average	Std. Dev.	Average	Std.Dev.	Av.	Std.Dev.		
January	6.50	6.01	0.05	0.06	0.43	0.69	69	87		10
February	6.09	6.14	0.06	0.07	0.42	0.70	68	72		10
March	5.34	5.04	0.07	0.08	0.39	0.54	62	70		12
April	4.56	4.06	0.09	0.10	0.47	0.76	66	80		11
May	4.14	3.83	0.11	0.12	0.49	0.74	66	86		11
June	3.23	2.65	0.11	0.15	0.37	0.56	74	110		10
July	2.79	2.36	0.12	0.19	0.35	0.52	73	93		10
August	3.27	3.08	0.11	0.15	0.39	0.68	84	97		9
September	4.53	4.99	0.10	0.12	0.48	0.73	87	98		8
October	4.97	5.15	0.08	0.10	0.44	0.66	106	128		7
November	6.13	2.76	0.08	0.09	0.55	0.83	100	87		8
December	6.85	6.96	0.05	0.04	0.42	0.67	80	92		9
Annual Av.	5.38	4.66	0.09	0.11	0.43	0.67	76	90	Annual Total	115
June-Aug. Av.	3.09	2.75	0.11	0.16	0.37	0.58	77	100	Summer Total	29
Sept.-May Av.	5.46	4.99	0.08	0.09	0.45	0.63	76	87	Non-Summer Total	86

MONTHLY RAINFALL STATISTICS SUMMARY FOR LITTLE ROCK, ARKANSAS

Exhibit 12



ANNUAL AND MONTHLY RAINFALL PATTERNS

LITTLE ROCK, ARKANSAS

Exhibit 13

Exhibit 14

FREQUENCY OF OCCURRENCE AND RETURN PERIOD FOR STORMS OF A GIVEN VOLUME FOR LITTLE ROCK, ARKANSAS

NWS STATION: #03 4248

PERIOD OF RECORD: 1949-1975

a.) Return Period

Return Period of Storm	Volume/Storm (inches)
1 month	1.13
3 month	2.07
6 month	2.56
1 year	3.23
2 years	3.85
5.6 years	5.58
7.0 years	5.92
9.3 years	6.81
14 years	7.71
28 years	7.96

b.) Frequency of Occurrence

Percentage of Occurrences Less Than or Equal To	Volume/Storm (inches)
1	0.011
5	0.014
10	0.018
15	0.023
20	0.030
25	0.041
30	0.054
35	0.069
40	0.094
45	0.12
50	0.16
55	0.21
60	0.27
65	0.34
70	0.44
75	0.55
80	0.67
85	0.87
90	1.17
95	1.73
99	3.09
100	7.96

III. PROBLEM ASSESSMENT

In approaching the study objectives Metroplan in conjunction with NURP consultants developed a Detailed Execution Plan (DEP) which was to guide the work through three years. The DEP called for an assessment of system-wide water quality and the development of detailed information on land uses, soils and slopes within the project area and its associated sub-basins.

Assessments completed during the three-year Fourche Creek study were of three types: (1) land use; (2) general water quality; (3) detailed water quality of BMP sites and assessment of pollutant loadings reductions.

A level two general land use study and soils study was performed of the entire Fourche Creek drainage basin at a scale of 1:20,000, and a far more detailed examination of land use, per cent imperviousness, and other parameters within the BMP test watersheds was completed at a scale of 1:1,000. (Summary Exhibits 2-4).

Water quality sampling and assessments during the first year of the project were general in nature and focused on defining the extent and nature of Fourche Creek pollutant levels system-wide. Eight sampling stations were located to yield a picture of Fourche water quality entering the metropolitan area and the impacts of tributaries draining the urban land uses. Coupled with the general water quality survey was a survey for the one-hundred-twenty-nine (129) toxics in which ten samples were analyzed for the presence of significant concentrations of metals, and organic compounds as part of the nationwide screening. (See Summary Exhibits 5-6).

During the second and final years of the Fourche Creek Project, water sampling efforts were concentrated in several test watersheds where BMP's were installed for evaluation.

After the initial assessment of the urban runoff impacts on Fourche Creek and its tributaries, the project studied the effectiveness of improved urban drainage systems and the parks as stream buffers to improve water quality.

A. Land Use, Slopes and Soils Assessment

In connection with the Fourche Creek NURP Project, Metroplan submitted a proposal for a test and demonstration project in July, 1980 to the Program for Technical Assistance in the Analysis of Land Resources, an agency within the United States Geological Survey's (USGS) Mid-Continent Mapping Center at Rolla, Missouri. The objective of the test and demonstration project was to provide Metroplan with the capability to generate maps and related statistics to support water resources planning for the Fourche Creek Project. The Program for Technical Assistance in the Analysis of Land Resources was established in October, 1978 through joint funding by the Ozarks Regional Commission (ORC) and USGS. The Program's primary purpose was to assist state and local governmental agencies in the use of USGS land use/land cover, associated map products and other natural resource data. Test and demonstration projects are but one method employed by the Program to fulfill this purpose. On October 1, 1980, the Program underwent some administrative changes and is now known as the Geographic Investigations Office (GIO). However, the primary purpose for the program has not changed.

Subsequent to the approval of the test and demonstration project proposal by the Program's Advisory Panel, Metroplan submitted a request for funding assistance from the ORC in July, 1980. The request for assistance was approved on October 1, 1980. The funding helped cover the cost of compiling and converting to a digital form map in the Little Rock area. The maps, showing land use and land cover changes, soils, and slope zone categories in the Fourche Creek basin, were used in the water quality study.

Project Plan

The project plan, as originally developed by the GIO and accepted by Metroplan, called for the basic data for land characteristics to be collected in three levels of detail, each successively covering a smaller geographic area and at a higher level of resolution.

The three levels of detail for mapping constituted three phases of the project. Because of time and cost constraints on the GIO, only the first two phases of the project were addressed during this project. The techniques developed in the first two phases, however, were useful in carrying out the final phase. The following map products and/or statistical summaries were to be available at the end of each phase:

1. Fourche Creek area (description at 1:100,000 scale)
    - corresponds to tasks 1, 2, 3 of the project plan
    - entire basin and major sub-basins delineated
    - level I and II land use/land cover for 1973 and 1980
    - general soils data
    - statistics of land use by sub-basin for 1973 and 1980

2. Urban Sub-basins of Rock, Grassy Flat and Coleman Creeks (at 1:24,000 scale)
   - corresponds to tasks 4-10 of the project plan
   - sub-basin boundaries and catchments delineated
   - level III and IV land use/land cover for 1980
   - detailed soils data
   - slope zones data
   - statistical cross-tabulation of land use by soils and slope for each sub-basin

3. Four individual catchments within Sub-basins (at 1:6,000 scale)
   - catchment boundaries
   - impervious, semi-pervious and rated pervious categories of land use/land cover
   - other data as needed

A detailed description of the proposed methodology and the changes made therein is covered in the following section dealing with the project work plan. The project work plan remained basically intact throughout the project. However, minor revisions, such as the deletion of the compilation of land use/land cover data for 1973 and 1980 on level I, were made. Instead, use was made of an available land use/land cover data base for 1973.

Work Plan

The initial work plan for the project was divided into two phases involving four and seven tasks, respectively. The initial work plan delineating these tasks and responsibilities is described below.

Initial Work Plan

The following tasks and responsibilities were delineated for Phase I of the project:

1. Revise land use/land cover data to 1980 for Fourche Creek sub-basins--
    - A. Metroplan will delineate and map hydrologic sub-basins of Fourche Creek.
    - B. The Program will be responsible for bringing the sub-basin map to a compilation scale of 1:40,000.
    - C. The Program will acquire available photography (1976 at scales of 1:40,000 and 1:80,000) and ensure its usability in compilation at a scale of 1:40,000 by photo-enlarging or reducing as needed.
    - D. Metroplan will acquire 1980 photography at 1:20,000 scale for use in revising the land use delineated from the 1976 photography for certain areas.
    - E. The Program will develop a base map mosaic at 1:40,000 from an available map of Pulaski county at 1:100,000 and selected 7.5 minute quads in adjacent areas of Saline county reduced to 1:40,000 scale.
    - F. The Program will provide a photo-enlargement of a 1973 land use/land cover map at 1:40,000 scale.
    - G. The Program will sponsor a workshop in Rolla to review the land use and sub-basin mapping methodology and to begin to prepare for the second phase of the project involving maps of detailed land use and catchment boundaries at 1:24,000.

Metroplan staff will compile land use/land cover from the photography provided. The land use/land cover will be delineated at a scale of 1:40,000 on a stable base, transparent overlay keyed to the base map mosaic and the sub-basins maps. The 1973 map can be used to orient and generally guide the land use/land cover revision for 1980.

2. Encode the 1980 sub-basins and land use/land cover for analysis--
   - A. The Program will sponsor a workshop in Rolla to cover the topic of encoding (i.e., converting mapped data from a graphic to a digital form).
   - B. Metroplan will code, keypunch and verify the 1980 land use/land cover maps.
   - C. Metroplan will code, keypunch and verify the sub-basins map.

3. Process the encoded data to produce 1973 and 1980 land use/land cover data by sub-basin statistics--
   - A. The Program will receive and review the encoded data.
   - B. The Program will build a comprehensive data base to support phase I activities consisting of 1973 and 1980 land use/land cover, general soils, and sub-basin codes.
   - C. The Program will generate land use/land cover statistics by soils for each Fourche Creek sub-basin.

The following tasks and responsibilities were delineated for Phase II of the project.

1. Develop a map of catchments for the urban sub-basins--
    - A. The Program will provide photo-repreductions of the contours and streams from the 7.5 minute quads at 1:24,000 for Rock, Grassy Flat, and Colemean Creeks (approximately 30 square miles).
    - B. Metroplan will delineate Rock, Grassy Flat, and Coleman Creek sub-basin boundaries and individual catchment boundaries at 1:24,000.

2. Develop a map of 1980 land use/land cover 1:24,000 scale--
    - A. The Program will photo-reduce available 1980 1:20,000 photography to the 1:24,000 scale for land use/land cover compilation.
    - B. Metroplan, in coordination with the Program, will revise a land use/land cover classification system for delineating level III and IV categories. The techniques for mapping will be reviewed in a workshop in Rolla (See 1G).
    - C. Metroplan will develop a land use/land cover overlay map. The overlay will be developed on a transparent, stable-base material and keyed to the map of catchments.

3. Develop a map of detailed soils data for the urban catchments--
    - A. Metroplan will transfer the detailed soils data for the urban watersheds to a transparent stable-base overlay at the published scale for the soils maps for Pulaski County.
    - B. The Program will photo-reduce the overlay to the 1:24,000 scale keyed to the map of catchments.

4. Develop a map of slope zones for the urban catchments -- Metroplan will transfer slope zone data from existing slope zone maps at 1:24,000 to a transparent overlay.

5. Encode the detailed land use/land cover, soils, and catchment boundaries for analysis--
   - A. Using the same techniques employed for encoding the data from phase 1, Metroplan will code data for land use/land cover, soils, slope zones, and catchments.
   - B. Program will keypunch and verify the data for land use/land cover, soils, slope zones, and catchments.

6. Process the encoded data to provide statistics by catchment--
   - A. The program will receive and review the encoded data from step 5.
   - B. The Program will build a data base to support phase 2 activities consisting of detailed land use/land cover, soils, slope zones, and catchment codes.
   - C. The Program will generate statistics of land use by each soil and slope zone code for each catchment (see attached sample).

7. Develop a final report critiquing the project -- Metroplan will develop a final report critiquing the project methodology. Ten (10) copies of the final report will be made available to the Program.

The tasks outlined in Phase I as 1A, 1D, 1G, 2B, 2C and in Phase II as 1B, 2B, 2C, 3A, 4, 5B and 7 are activities that were undertaken with assistance provided through the ORC grant. Comments regarding these tasks, as well as the entire project, are included in the following sections. The completed work plan developed differently from the Initial Work Plan in scheduling, scope of work and phasing. The Work Plan, as completed, is illustrated on the following page. Comments regarding the plan are made in the following section.

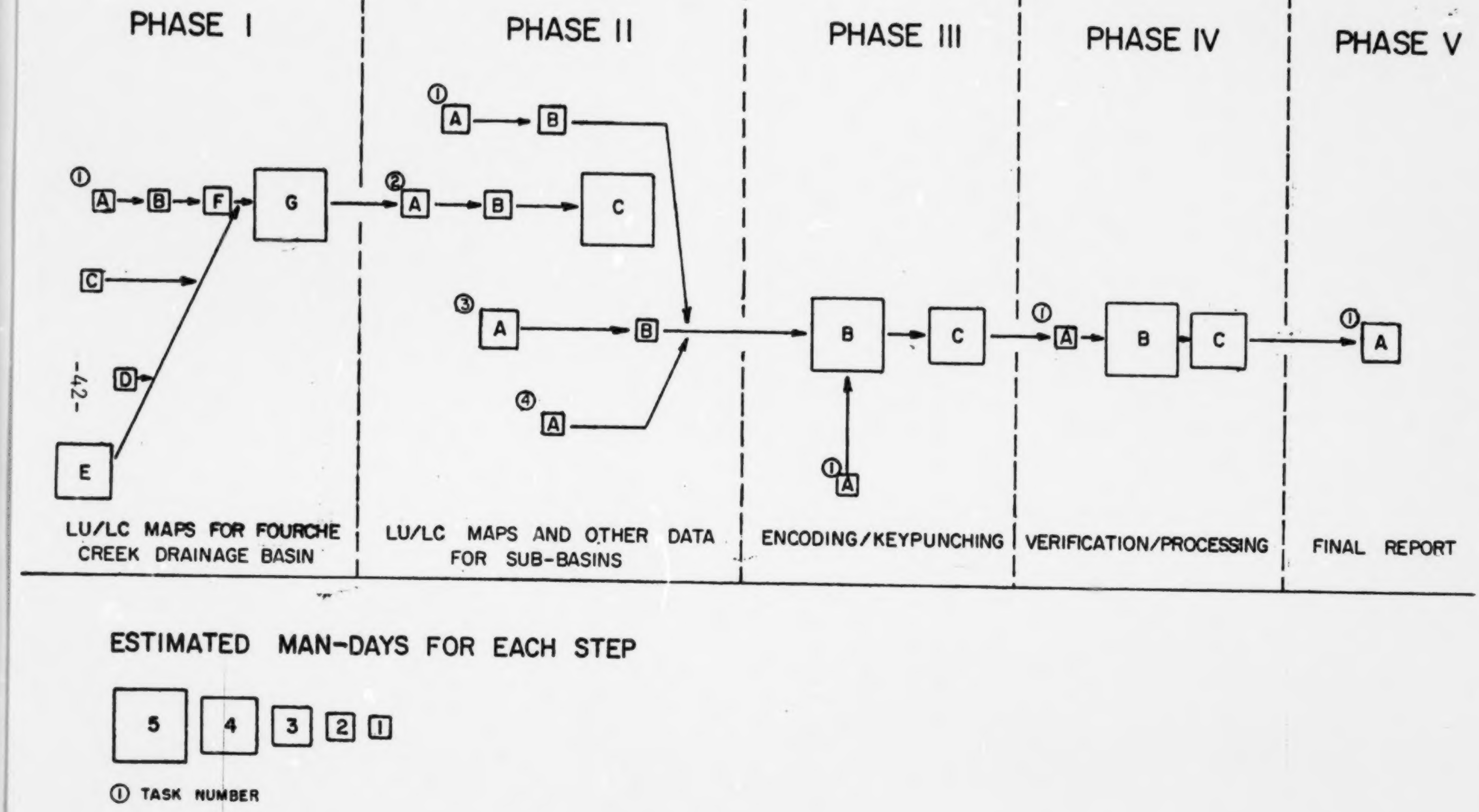

PHASE I
PHASE II
PHASE III
PHASE IV
PHASE V
①
A
B
F
G
C
D
E
②
A
B
C
①
A
B
③
A
B
④
A
B
C
①
A
①
A
B
C
①
A
LU/LC MAPS FOR FOURCHE CREEK DRAINAGE BASIN
LU/LC MAPS AND OTHER DATA FOR SUB-BASINS
ENCODING/KEYPUNCHING
VERIFICATION/PROCESSING
FINAL REPORT
ESTIMATED MAN-DAYS FOR EACH STEP
5
4
3
2
1
① TASK NUMBER

Exhibit 15

WORK SCHEDULE AND TIME ESTIMATES

METROPLAN NURP PROJECT

Discussion of Project Methodology

Phase I - Mapping of Land Use and Land Cover for Fourche Creek Basin

The mapping of land use/land cover and other natural resource data was accomplished in the same manner throughout the project, despite the level of detail and scale required. A stable based material overlay was keyed to a transparent base map which overlayed a recent photograph at the same compilation scale. These items were then used to identify and delineate appropriate polygons. The land use/land cover classification system used during the project was adopted from a previous test and demonstration project conducted by GIO. It is a multi-level land use classification system which can be modified to meet any degree of detail(Anderson and others, 1976).

As initially proposed in the work plan, every major hydrological sub-basin within the Fourche Creek Basin was to be delineated and mapped to provide NURP with the capability to determine the appropriate land use/land cover, soils and slope data by sub-basin. However, the determination of the location and number of sampling stations early in the project dictated the need for delineation of only three hydrological sub-basins, Rock, Grassy Flat and Coleman Creeks. The remaining portion of Fourche Creek Basin was not divided into sub-basin areas. The production of the basin and sub-basin overlay was accomplished at a scale of 1:62,500 and then enlarged to the Phase I compilation scale of 1:40,000.

The photography used as a base for the 1:40,000 scale mapping was taken in 1976 at nominal scales of 1:40,000 and 1:80,000 and photo-enlarged or reduced as necessary. The delineation of existing land use/land cover on level II basis was accomplished and then checked with 1980 photography for accuracy and changes occurring between 1976 and 1980.

It would have been simplier to use the 1980 photography originally, but the 1980 photography was not available until later in the project.

As a check against the 1980 land use/land cover maps generated through NURP, the work plan called for the reproduction of the 1973 land use/land cover maps for the four-county central Arkansas area at a scale of 1:40,000. The reproduction had to include the entire four-counties. Consequently, the quality of the land use/land cover for the Fourche Creek Basin proved to be too general for any meaningful comparisons.

Phase II - Mapping of Land Use/Land Cover for Soils and Slopes for Sub-Basins

The delineation of Level III land use/land cover, soils and slope data was accomplished at a scale of 1:24,000 for the three sub-basins using the same process as outlined earlier with the only difference being the base year of the photography used. The 1980 photography, acquired early in the project at a scale of 1:20,000, was reduced to the compilation scale of 1:24,000 and used in the delineation of the land use/land cover data. The 1980 photographic base not only saved time in delineating current land use/land cover boundaries, but also increased the accuracy of identification.

The process involved in the mapping of the soils and slopes for the three hydrological sub-basins was similar to the process described for the land use/land cover mapping. Soils data for Rock, Grassy Flat and Coleman Creeks are contained in a publication entitled, "Soil Survey of Pulaski County, Arkansas", (USDA, Soil Conservation Service, 1975). The soils are shown on a detailed map developed from aerial photographs. This map is divided into sheets and given a corresponding number for publication. On each sheet of the detailed map, soil areas are outlined and identified by symbols. These sheets are published at a scale of 1:20,000. Consequently, to encompass the entire geographical area drained by Rock, Grassy Flat, and Coleman Creeks, six of these sheets had to be utilized. A mosaic of these sheets was made and overlayed with a stable based material on which the polygons were transcribed. The resulting detailed soils map of the three sub-basins was reduced to the compilation scale of 1:24,000 for encoding. The basin outlines were superimposed from the outline on the 1:24,000 topographic maps so that areas outside the outer basin boundaries were not encoded.

Phase III - Encoding the Mapped Data

After map overlays for land use/land cover, soils, and slope zones were completed, the GIO sponsored a week-long training workshop in Rolla on encoding the data (i.e., converting the data into a computer-readable form). The map overlays were encoded in a semi-automatic fashion using an electronic lanimeter with digitial read-out and, later, in an automatic mode using a digitizer available to the Arkansas Highway Department.

At the workshop, the procedures for encoding were explained and demonstrated. The land use/land cover overlays for the 1:24,000 scale maps covering the sub-basins area were encoded during the workshop along with two of the slope zone overlays. The other slope zone overlays and the soils overlay for the sub-basins were encoded using the same concepts on the digitizing equipment. This equipment was used to encode the level II land use/land cover overlay for the Fourche Creek basin and an overlay showing the catchment areas within the sub-basins at 1:24,000 scale.

The procedures for encoding the data were relatively straightforward and basically the same approach was used regardless of the scale of the map overlay or the equipment used for encoding. An overlay strip containing a series of parallel horizontal lines within a rectangle was placed over the map overlay. The rectangle represents an area one kilometer north to south by "n" kilometers east to west and it was aligned over fiducial marks on the map overlay denoting even 1000 meter intervals in the universal transverse mercator (UTM) planar coordinate grid (See Figure 1). The fiducial marks were obtained from the grid tick marks on the topographic maps.

The mapping of slope zone information for the three sub-basins involved the process of overlaying four quadrangles slope zone maps, produced by the Arkansas Geological Commission in cooperation with USGS, with stable based material and then transferring the zone boundaries, in a generalized form, to the overlay. This process produced a map overlay at a scale of 1:24,000 displaying five slope zones ranging in the degree of slope from 0-3 per cent to over 30 per cent. This overlay was then encoded as described in the following section.

Exhibit 16

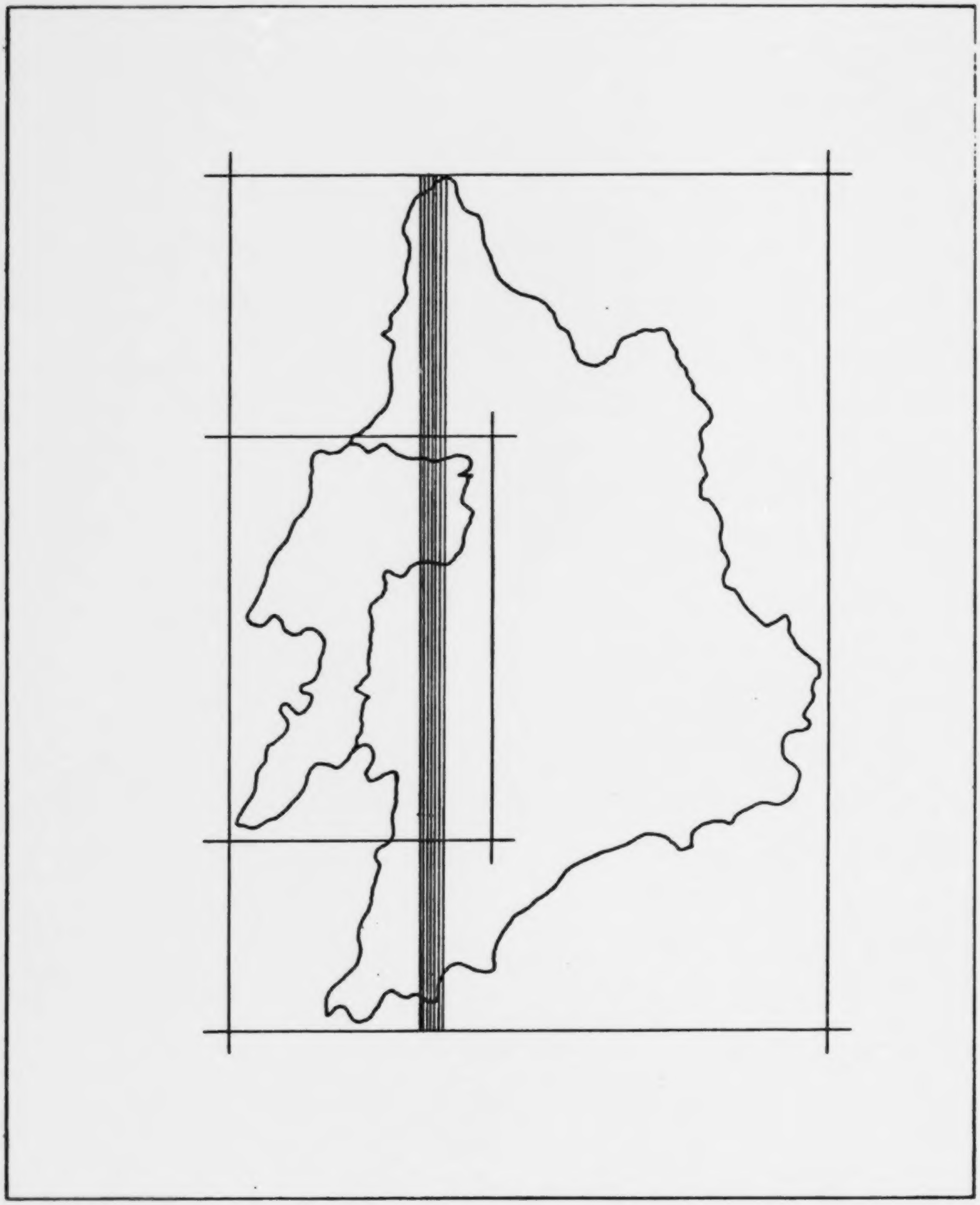


Figure 1 -- Overlay strip of 1 by n kilometers used for encoding

Once the overlay strip was in place, the cursor (ie, the aiming device for the encoding equipment) was moved horizontally left to right along a line. The X coordinate position of each intersection of the line with the map sheet and polygon boundaries was recorded. In addition, the attribute (ie, the polygon code) to the left of each of the intersection points was also recorded. In the case of the electronic planimeter equipment, these occurrences were recorded by hand on a coding form and later keypunched. The digitizing equipment at the Arkansas Highway Department automatically punched these "ending X" positions and the associated attributes were entered by the operator through a keyboard.

Each of the parallel lines represents the connected center points of adjacent columns of grid cells along a row; that is, the centerline of a row. After the ending X positions along each of the rows were encoded, the ending X positions were translated into ending column locations. The data were stored in this format for manipulation, retrieval, and analysis (See Appendix A - Description of Data Files.)

The study areas for Fourche Creek basin and the sub-basins were subdivided into grid cell sizes of 100 meters and 50 meters square respectively. A local UTM frame of reference was established for each of the study areas by identifying the extreme 1000 meter intervals which circumscribe the areas. Within these defined limits, each kilometer interval from north to south was sub-divided for encoding as described above.

Phase IV - Processing the Data for Fourche Creek Basin

The 1980 Level II land use/land cover overlay for Fourche Creek was merged with other elements of an existing data set which included land use/land cover for 1973, soils association data and county and census unit boundaries definitions. These data were developed in 1974 by the Geographic Applications Program of the U.S. Geological Survey (now known as the Office of Geographic Research, National Mapping Division). The data elements were developed on map overlays, digitized and processed by software which has evolved into the Geographic Information Retrieval and Analysis System (GIRAS) of the Office of Geographic Research (Mitchell and Others, 1976). The boundary lines and codes from the overlays were recorded as X, Y coordinates and subsequently converted by computer program to a grid cell of 200 meters square based on the UTM planar coordinate system. These data sets were developed for a four-county area in the Little Rock Metropolitan area.

The local UTM frame of reference for the Fourche Creek basin was superimposed over the digital data for the four county area in order to extract the 1973 land use/land cover, soils, county and census data for the rectangle in and around the Fourche Creek basin (see Figure 2). A soils association map overlay was not presented since the digital data were developed from work maps only and a presentation overlay was not developed. In order to integrate the 200 meter grid cell data with 100 meter data for the 1980 land use/land cover overlay, a subsequent program resampled the 200 meter data and wrote two rows of data for each row read. After the resampling, the existing data elements were merged with the data from the 1980 land use/land cover overlay to form a composite data file.

Exhibit 17

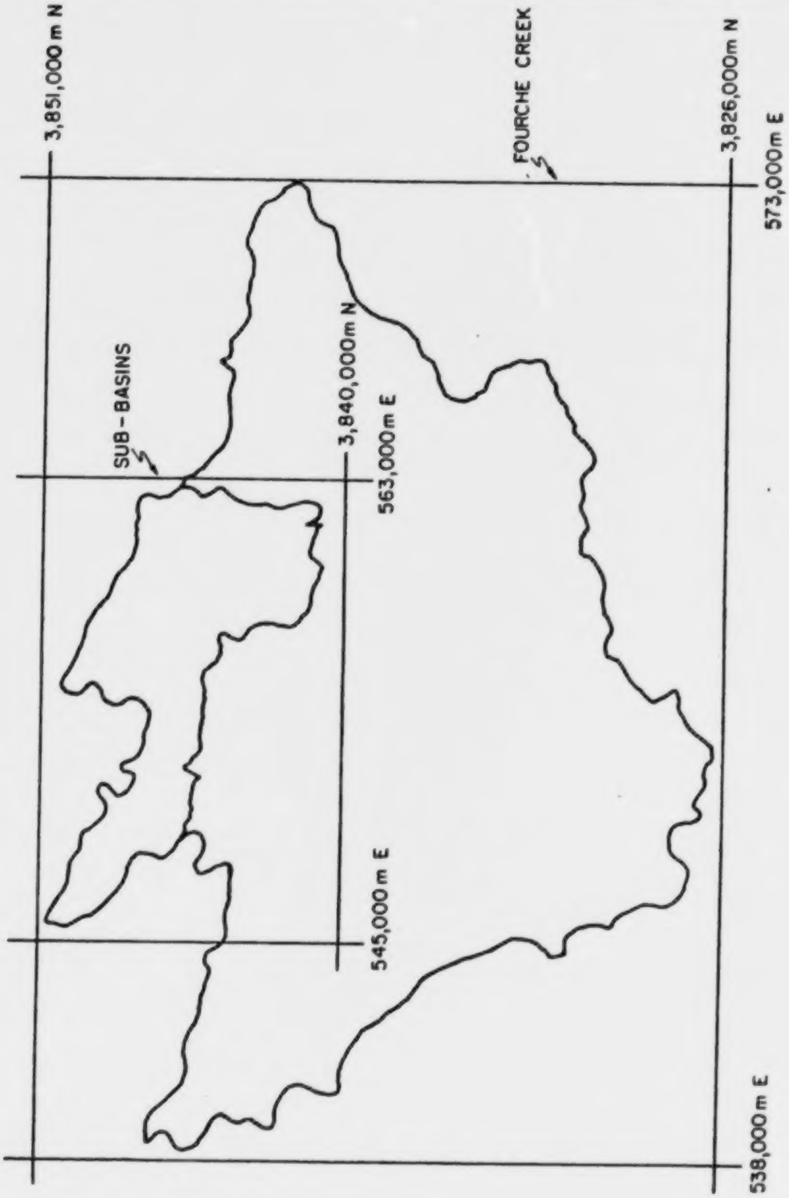

3,851,000 m N
FOURCHE CREEK
3,826,000m N
573,000m E
SUB-BASINS
3,840,000m N
563,000m E
545,000m E
538,000m E

Figure 2 - Georeferencing frames for Fourche Creek and Sub-basins study areas

Since the 1980 land use/land cover was only delineated for the area inside the basin (ie, areas outside the basin were assigned a land use code of "0"), the grid cells with a zero code for 1980 land use/land cover were eliminated. This, in effect, eliminated all grid cells in the rectangular frame of reference, but not actually in the basin (see Figures 3 - 6).

After the grid cells outside the basin were eliminated, a tabular file was created from the composite data file. This file parallels the composite data file except that, instead of an ending column position, the number of grid cells are reported for the string of contiguous columns possessing the particular composite attributes (See Figure 7). The tabular file is then sorted for subsequent processing by a tabulation report generating program which produces formatted output.

For Fourche Creek basin, the tabular file was sorted primarily by census unit codes and, within census units, by soils association codes, then land use codes. In a similar fashion, the same data file was sorted by census unit, by land use/land cover code for 1973, then by land use/land cover code for 1980. In this way, it was possible to produce a tabular report of land use by soils from the first file and from the second, and a tabular report showing land use changes within census units between 1973 and 1980.

Exhibit 18

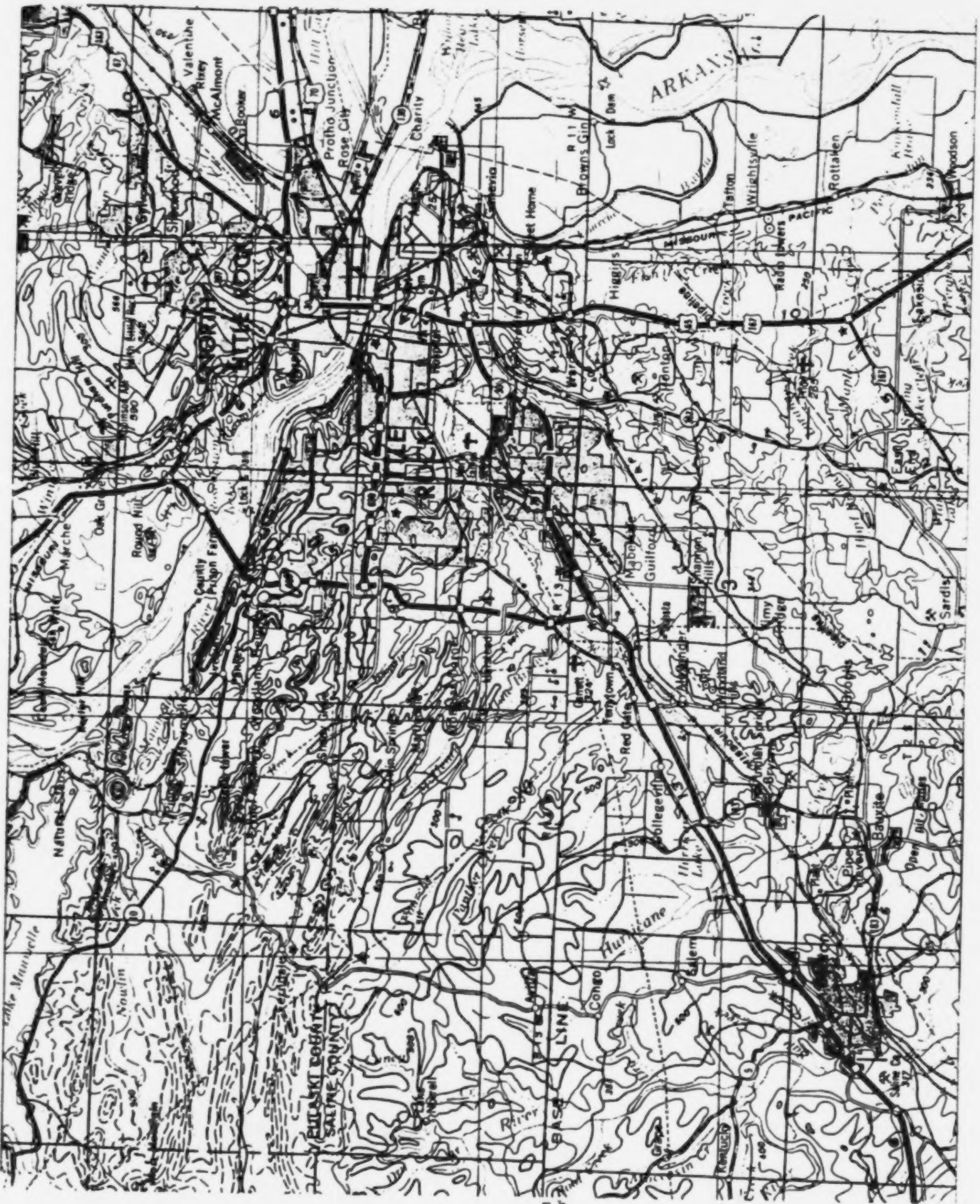

ARKANS
Valentine
Riley
McAlmont
Booker
Protho Junction
Rose City
Charity
Browns Gin
Sweet Home
Higgins
Tafton
Wrightsville
Rottaken
Woodson
MISSOURI PACIFIC
Round Hill
Marche
Mabelvale
Guilford
Sardis
Natural Steps
Collegeville
Hurricane
Salem
Congo
BASE LINE
PULASKI COUNTY
SALINE COUNTY

Figure 3 - Outline of Fourche Creek basin over the 1:250,000 topographid map

Exhibit 19

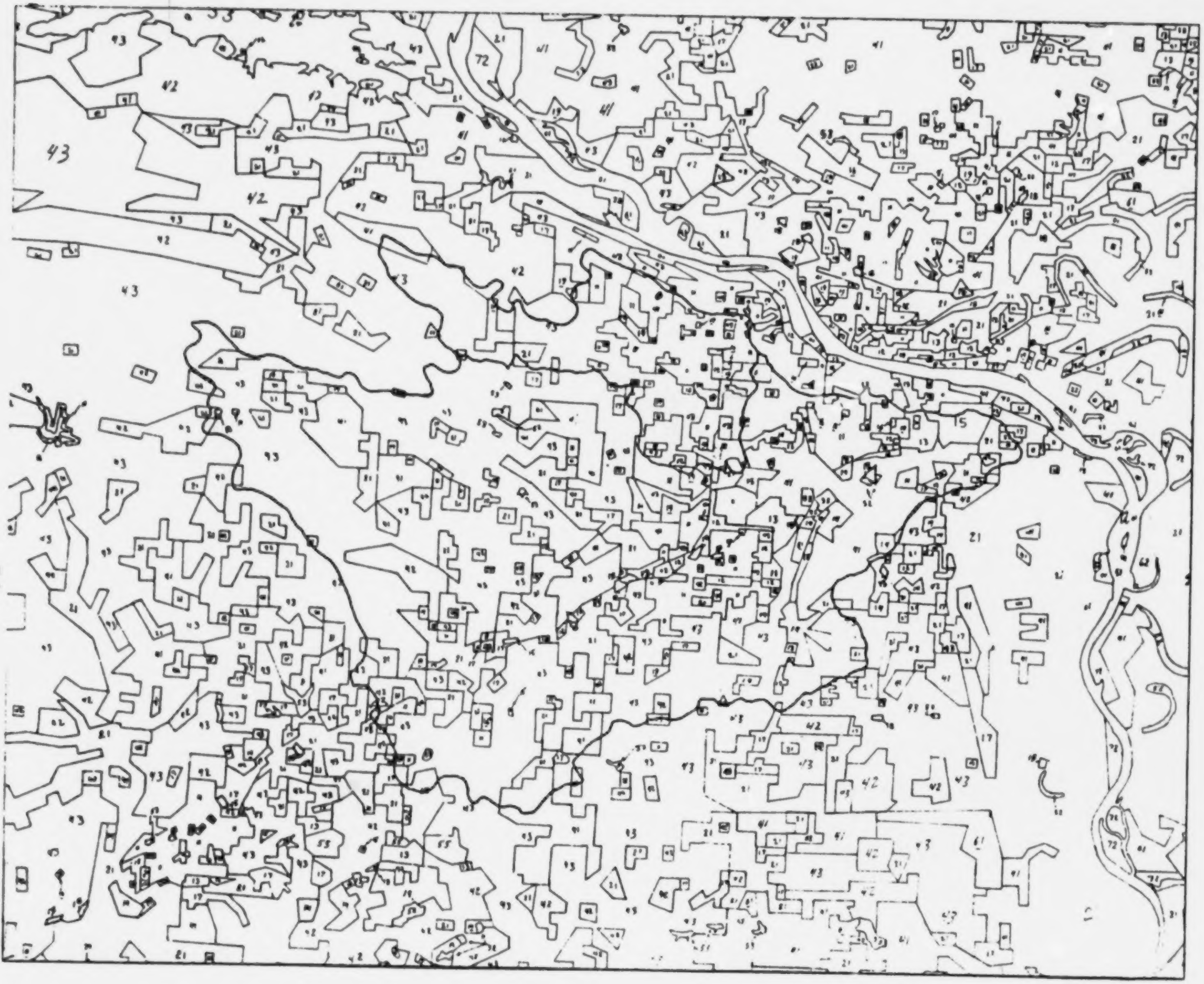


Figure 4 - Land use and land cover in Fourche Creek basin
(For description of Land Use codes, see VolumeII, "Land Use Classification System")

Exhibit 20

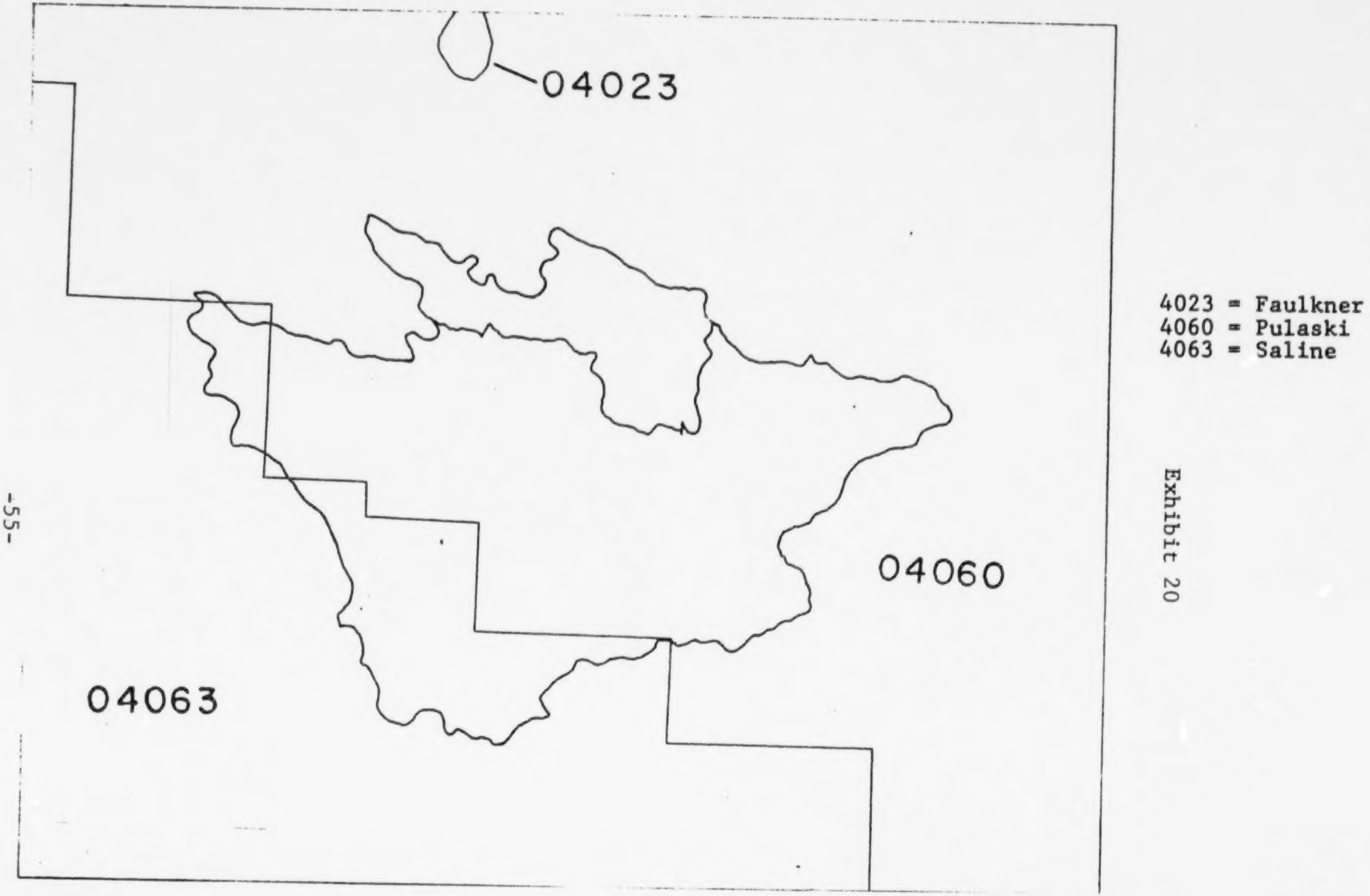

04023
04060
04063
4023 = Faulkner
4060 = Pulaski
4063 = Saline

Figure 5 - County boundaries in the Fourche Creek basin

Exhibit 21

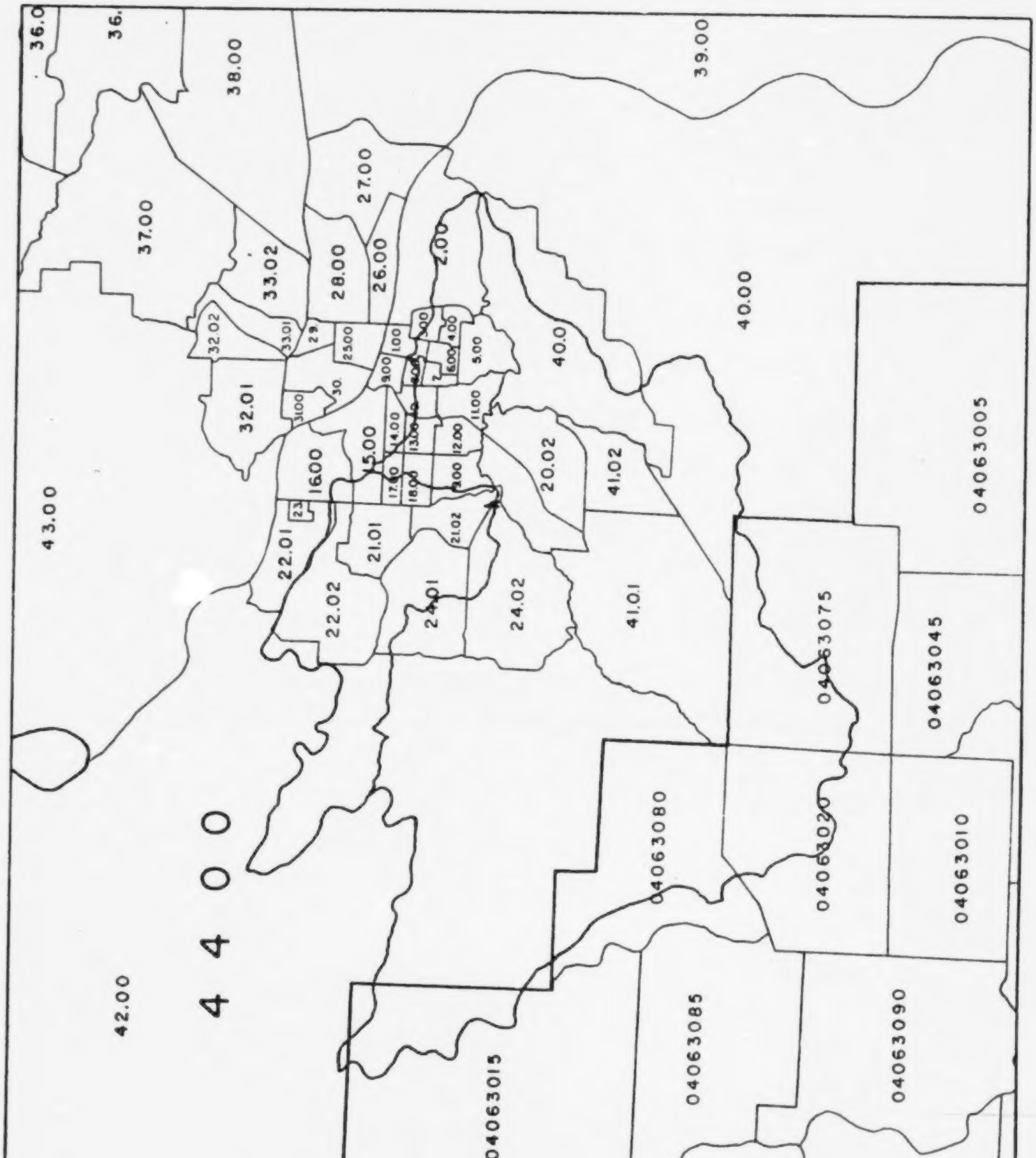

36.0
36.
38.00
39.00
37.00
27.00
33.02
28.00
26.00
2.00
32.02
33.01
29
25.00
100
200
400
9.00
8.00
6.00
5.00
40.0
40.00
32.01
3100
30
11.00
15.00
14.00
13.00
12.00
16.00
17.00
18.00
1900
20.02
41.02
43.00
23
22.01
21.01
21.02
22.02
24.01
24.02
41.01
04063005
04063075
04063045
04063080
04063020
04063010
4400
42.00
04063085
04063090
04063015
063070
55

Figure 6 - 1970 Census Unit boundaries in the Fourche Creek basin

Processing Data for the Sub-basins

Once the various map overlays for the sub-basins were encoded, it was necessary to merge those developed from individual map sheets. This "sheet merging" process was necessary to combine the map overlays for land use/land cover and slope zones from the Pinnacle Mountain, Alexander, North Little Rock, and Little Rock quadrangles into a single file. For the detailed soils overlay and catchment overlay this step was not necessary since an individual sheet was created for each of these attributes.

After a single file was created for each of the attributes, an "attribute merge" program was executed to develop a composite data file for all attributes. The objective in establishing a composite data file was to facilitate subsequent analysis and generation of statistics. Two files were created during the attribute merge process. The first was the composite data file showing the coincidence of the attributes with spatial location described for each record. The second file was a parallel to the first containing the composite attributes and the number of grid cells associated with the composite attributes (See Appendix A - Description of Data Files). From the second file, cross-tabulations of land use/land cover by detailed soils within slope zone classes and catchment areas were generated. As with the data for the entire Fourche Creek basin, sorting the attribute codes in the desired order.

Future Application of the Digital Data

From the digital data files, the only products generated to date have been cross-tabulation reports. It is expected that the tabulations can be used in correlating land characteristics information with observed water quality values. From this baseline evaluation, it should also be possible to anticipate the changes in water quality which will arise from changes in land use/land cover, soils, and slopes, then the simulated changes could be so refined.

The composite data files with locational attributes (i.e. row and column) have been utilized initially to generate tabulation files used in creating the reports. There are many potential applications of these data for water resources - related planning and other planning efforts. The major potential applications were:

- Utilize the Universal Soil Loss Equation to generate estimates of the sediment contribution of areas. Rank these into groups and display "highest to lowest" areas contributing to sediment problems.

- Apply "loading factors" to specific land use/land cover types (or land use/land cover types in concert with slopes and soils data) to estimate the amount and source of specific types of pollution.

- Identify and generate a computer map of areas which have steep slopes, highly erodable soils, and land use/land cover that could lead to problems of erosion. Such maps could be used to identify areas where specific management techniques are needed to curtail major problems of erosion.

- Generate maps showing residential, commercial, or industrial areas where soils are not suitable for septic tank filter fields. Areas such as these not served by a sewer facility may be contributing to groundwater pollution which subsequently enters the stream system.

- Identify areas with little or no limitations for development to help guide land use changes in the basin area. The sub-basins data could be used for large planned developments by helping developers prepare site plans consistent with the capabilities of the land resource.

These are some of the ways in which the digital data were used to further the study of water resource problems in the Fourche Creek basin and sub-basins.

The primary objective of the project was to provide Metroplan with the capability to generate maps and related statistics to support water resources planning for the Fourche Creek NURP Project. The process described in this report accomplished that objective by producing:

- reproducible maps of land use, soils and slopes for the three sub-basin areas
- reproducible maps of land use for the entire Fourche Creek Basin
- necessary statistical tabulations.

The project also provided Metroplan with:

- the capability to extract land use, soils or slope data for any identified catchment area within the sub-basin area
- the potential to evaluate the impact of any potential management technique upon a catchment, sub-basin or basin area
- the ability to transfer much of the knowledge and technology gained through this project to other work efforts that may lend themselves to the process developed in this project.

B. Water Quality Analysis

The objectives of the first year sampling program were to generate data which indicated the extent of urban nonpoint source problem, to isolate areas having water quality degeneration, to determine stormwater loadings, to calibrate receiving water models, urban runoff models, and in general to establish basics for analysis of the effectiveness of BMP's.

The NURP sampling program was proposed to last approximately thirty (30) months and was composed of activities to identify water quality problems, to locate to the extent possible their origin, to measure water quality parameters in conjunction with the implementation of one or two Best Management Practices (BMP's) as a means for evaluating their effectiveness, to sample urban runoff to determine if toxic and trace organic compounds were evident, and to determine urban stormwater loads that tributaries of Fourche contribute to its main stem.

During the first year, the emphasis of the sampling program was directed at determining the background conditions present in Fourche Creek by sampling the creek and its tributaries on a routine basis during wet and dry weather seasons (Exhibits 22-27). Rainfall runoff events were sampled to develop pollutant loads being generated as a result of nonpoint source urban sources.

As data were developed, the sampling was modified to respond to changes which were required. Runoffs from isolated watersheds with predominant land use patterns were sampled to calibrate an urban runoff model "storm."

Exhibit 22

TABLE 1

SAMPLING STATIONS FOR 1st 12 MONTHS

Code #	BiWeekly 26 Samples	Rainfall Event Sampling Composite North	Rainfall Event Sampling Composite South	Land Use Calibration	
AR1010		X		X	Grassy Flat on Reservoir Road
AR1020		X		X	Rock Creek on W. Markham
AR1040	X	X		X	Rock Creek on W. 36th
AR1053	X		X		Fourche Creek on Highway 5
AR1063	X				Fourche & University
AR1073	X		X		Fourche & Lindsey Rd.
AR1080	X		X		Little Fourche on 3M Railroad Spur
AR1090		X		X	Coleman Creek & Asher

Exhibit 23
TABLE 2

LITTLE ROCK NURP
SUMMARY OF 1st YEAR SAMPLING

	BOD_5	TSS	TP	TN	Fecal Coli	Pb	Zn	Cr	Al	(129)	Rain	Field Measure-ments	COD
Dry Weather	130	130	130	130	130		130			8	130	130	130
Rainfall Event Composite North	16	16	16	16	16	16	16	16		4	16	16	16
Rainfall Event Composite South	12	12	12	12	12	12	12	12	12	3	12	12	12
Land Use Calibration 4 Sites/ 7 Samples 3 Times/Year	84	84	84	84	84	84	84	84	84		84	84	84
	242	242	242	242	242	112	242	112	96	15	242	242	242

Exhibit 24

TABLE 3

LITTLE ROCK NURP
BIWEEKLY SAMPLING

Year 1

DRY WEATHER

	BOD	TSS	TP	TN	Fecal Coli	Metal	(129)
AR1040	26	26	26	26	26	26	1
AR1053	26	26	26	26	26	26	1
AR1063	26	26	26	26	26	26	1
AR1073	26	26	26	26	26	26	1
AR1090	26	26	26	26	26	26	1
	130	130	130	130	130	130	8

Exhibit 25

TABLE 4

RAINFALL EVENT
NORTH COMPOSITE SAMPLE

4 times/yr.

		BOD	SS	TN	TP	Fecal Coli	Metal	129	Field Measurements	COD	Cr	Pb
1	AR1010	4	4	4	4	4	4	1		4	4	4
2	AR1020	4	4	4	4	4	4	1		4	4	4
3												
4	AR1040	4	4	4	4	4	4	1		4	4	4
5												
6												
7												
8												
9	AR1090	4	4	4	4	4	4	1		4	4	4
		16	16	16	16	16	16	4		16	16	16

Exhibit 26

TABLE 5

RAINFALL EVENT
SOUTH COMPOSITE SAMPLE

4 times/yr.

		BOD	TSS	TP	TN	Fecal Coli	Metal	129	COD	Al	Pb	Cr
1												
2												
3												
4												
5	AR1053	4	4	4	4	4	4	1	4	4	4	4
6												
7	AR1073	4	4	4	4	4	4	1	4	4	4	4
8	AR1080	4	4	4	4	4	4	1	4	4	4	4
		12	12	12	12	12	12	3	12	12	12	12

Exhibit 27
TABLE 6

LITTLE ROCK NURP 1st YEAR
RAINFALL EVENT LAND USE CALIBRATION

4 Sites/3 Times/yr

		BOD	TSS	TP	TN	COD	Field Measurements	
1	AR1010	21	21	21	21	21	21	7 Samples/Event
2	AR1020	21	21	21	21	21	21	7 Samples/Event
3								
4	AR1040	21	21	21	21	21	21	7 Samples/Event
5								
6								
7								
8								
9	AR1090	21	21	21	21	21	21	7 Samples/Event
		84	84	84	84	84	84	

A Quality Assurance Program as specified by the Environmental Protection Agency (EPA) guidelines was included as a part of the sampling program. A description of the requirements of the Quality Assurance Program is attached as an Appendix to this report.

The University of Arkansas at Little Rock and Metroplan jointly selected specific sampling sites for the work required. These are listed below with data derived for each station. Where "Field Measurements" is listed as a parameter, these included the temperature, ph, DO, flow, time, rainfall, specific conductance and antecedent conditions.

Specific sampling sites were selected on the basis of accessibility, ability to sample the site during rainfall/runoff events, how well runoff at the site represented water quality from the basin and ability to determine instantaneous discharge for each sample pulled from the site.

All samples were collected, preserved, transported, and analyzed according to the techniques and procedures of "Standard Methods for the Chemical Analysis of Water and Wastes" 1974, by the Environmental Protection Agency. Where instantaneous discharges were required as a part of the sample information, the discharge estimates were made using measured velocities and cross sectional flow areas, stage-discharge ratings, or other methods. Field personnel utilized were properly instructed and trained to assure correct sampling, preservation, and transportation techniques. Quality control was assured through nonroutine checks of the field and laboratory work. In compliance with

Environmental Protection Agency requirements UALR analyzed duplicate and spike samples for 10 per cent of all the samples collected and analyzed under this contract. The analyses for duplicate samples and spike samples were considered as a part of the total laboratory analyses required under contract.

For those stations titled as "BiWeekly" the parameters are listed in Table 3. The samples were collected on every other week during both dry weather and wet weather periods. The samples were collected without waiting for a rainfall, but taken on a routine basis.

For those stations titled "Rainfall Event Composite Sample North" the samples were collected during a rainfall event which produced a definable hydrograph (Table 4). The composite samples were made up of at least seven flow proportional samples, with three (3) taken on the rising leg of the hydrograph and four (4) taken after the peak of the hydrograph. To the extent possible the stations which comprised this sampling effort were taken during the same rainfall/runoff event.

For the stations titled "Rainfall Event Composite South," Table 5, the same procedures as outlined for the "North" composites were followed.

For the stations titled "Land Use Calibration," Table 6, the sampling was conducted during a rainfall/runoff event which produced a definable hydrograph with at least seven (7) discrete samples taken for analysis during the runoff event. At least three (3) samples were taken during the rising leg of the hydrograph and four (4) samples collected after the peak of the hydrograph.

Priority pollutants were collected during the first year's sampling efforts. The stations and frequency for collecting are noted in Tables 2 through 5 and are listed as "(129)". The samples were collected, preserved and transported to an EPA-contracted laboratory for analysis. Metroplan approved the use of the laboratory. The details for the collection procedures are in the appendix.

Under ideal conditions it was intended that a maximum of 170 sampling trips would be required to collect and analyze a maximum of 242 samples/year. The duplicate and spike samples analyzed for quality control purposes were considered as regular analyses and therefore enumerated as part of the total samples.

Data from the sampling program are presented in the separate "Data Report" accompanying this main report.

Included in the sampling program was the priority pollutant sampling as required by EPA. A list of the priority pollutants which were analyzed is attached (see Appendix B). The procedures for collection, handling and analysis of the samples as outlined in EPA Information Memorandum INFO-80-67, April 28, 1980 were followed.

The water quality analysis program includes a procedure of quality assurance. The requirements of this program are attached to this report as an appendix. The Chemistry Department of the University of Arkansas at Little Rock was responsible for the sampling and quality assurance program as a part of the scope of work under this contract with Metroplan.

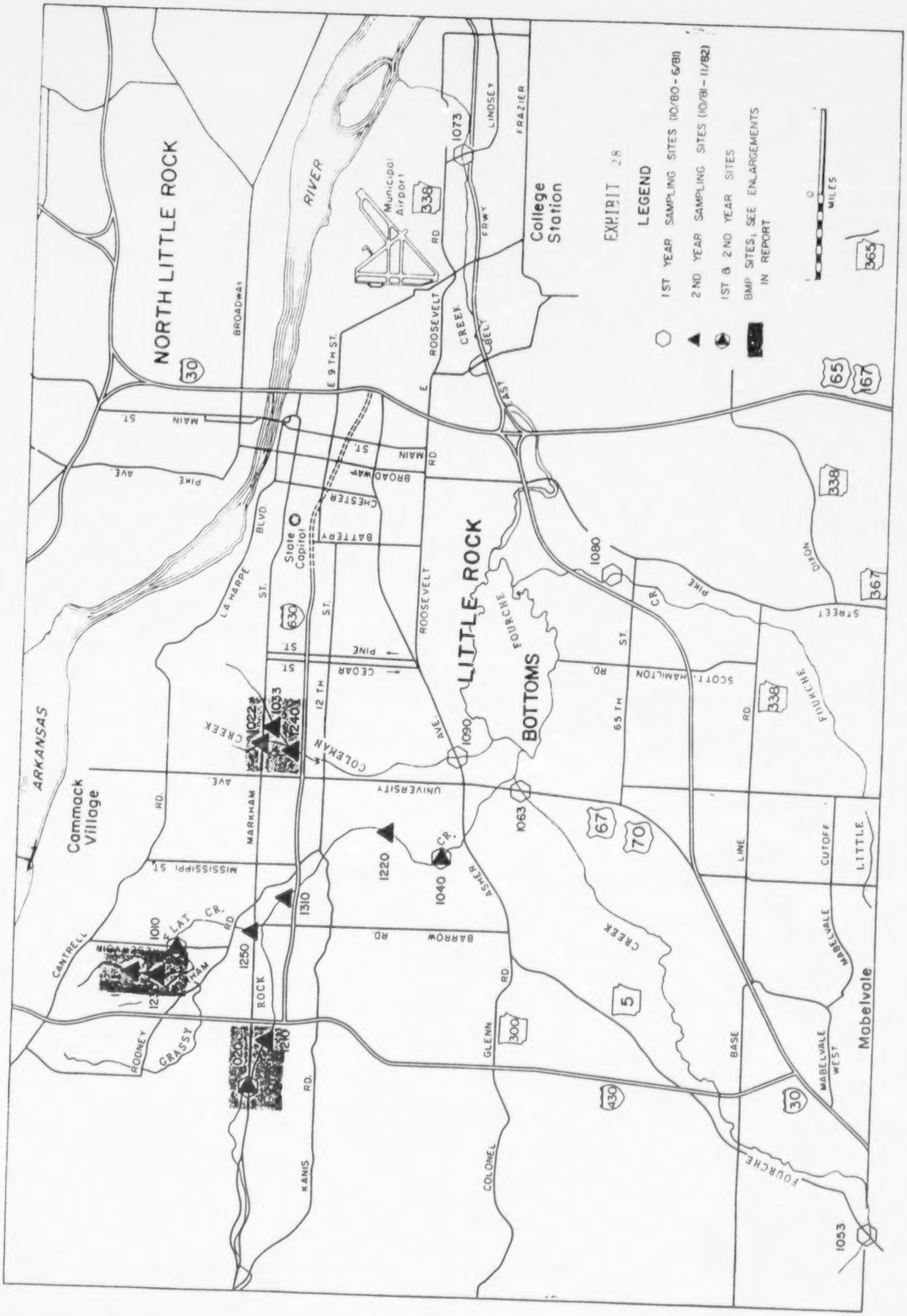


EXHIBIT 28
LEGEND
⬡ 1ST YEAR SAMPLING SITES (10/80-6/81)
▲ 2ND YEAR SAMPLING SITES (10/81-11/82)
◉ 1ST & 2ND YEAR SITES
▨ BMP SITES; SEE ENLARGEMENTS IN REPORT
0
MILES
NORTH LITTLE ROCK
LITTLE ROCK
ARKANSAS
RIVER
Commack Village
College Station
Municipal Airport
State Capitol
FOURCHE
BOTTOMS
Mabelvale
BROADWAY
MAIN ST.
PIKE AVE.
E 9TH ST.
E. ROOSEVELT RD
CREEK
EAST BELT FRWY
LINDSEY
FRAZIER
ROOSEVELT
LA HARPE BLVD
BATTERY
CHESTER
BROADWAY
MAIN ST.
PINE
CEDAR
12 TH
ST.
ST.
MARKHAM
COLEMAN CREEK
UNIVERSITY AVE.
ASHER AVE.
65 TH ST.
SCOTT HAMILTON RD.
PIKE
DIXON
STREET
FOURCHE
MISSISSIPPI ST.
RD.
CANTRELL
RODNEY
GRASSY
FLAT CR.
RD
ROCK
HAM
BARROW RD.
CR.
CREEK
KANIS RD.
GLENN RD
COLONEL
BASE LINE
CUTOFF
LITTLE
MABELVALE WEST
MABELVALE
FOURCHE
30
65
167
338
338
338
367
365
630
67
70
5
300
430
30
1073
1080
1090
1063
1040
1220
1310
1250
1010
1020
1210
1022
1033
1240
1053

Conclusions

The first year analysis of data confirmed that urban runoff contributes to elevated pollutant levels in Fourche Creek. Graphs representing partial sampling results from stations along Fourche Creek demonstrate that there is a definite deterioration in water quality during a storm event (see Exhibits 29-31).

The water quality deteriorates as it passes through Little Rock except in the Fourche Creek bottoms, a wetlands section of the Creek, where the BOD, COD and SS levels are reduced. However, conversely TKN and TP actually increase as the water passes through the bottoms. The U.S. Geological Survey Model of the Fourche system attributes these observations to the effects of settling and re-suspension in the bottoms.

System-wide first year sampling showed that a large portion of the urban runoff problem in Little Rock is in large measure traceable to Rock Creek. It was decided to focus subsequent project efforts on this major tributary. Consequently, a scope of work to perform the required elements was prepared and implemented during the eighteen months following the completion of the first year sampling.

(Urban) SITE 1040		Avg. value dry weather samples	Event Mean Concentration From Storm Events			
			10/17/80	11/14/80	2/1/81	5/17/81
BOD	mg/l	2.38	10.3	5.74	8.60	5.58
COD	mg/l	9.35	42.1	27.2	31.0	65.2
S.S.	mg/l	5.83	694	163	206	535
TKN	mg/l	0.61	1.45	1.50	1.36	1.54
TP	mg/l	0.171	0.268	0.173	0.422	0.41
Fe.coli		570	N/A	N/A	N/A	N/A

(Rural) SITE 1053		Avg. value dry weather samples	2/10/81	2/28/81	3/21/81	5/17/81
BOD	mg/l	2.82	4.76	2.90	2.24	1.91
COD	mg/l	11.5	8.47	44.6	16.5	29.7
SS	mg/l	3.96	49.0	58.4	12.3	91.0
TKN	mg/l	0.48	1.19	1.34	0.928	0.83
TP	mg/l	0.13	0.557	0.122	0.259	0.29
Fe.coli		487	N/A	N/A	N/A	N/A

(Mixed) SITE 1080		Avg. value dry weather samples	2/28/81	5/25/81	6/3/81
BOD	mg/l	2.4	2.02	N/A	N/A
COD	mg/l	14.7	3.16	25.8	30.6
SS	mg/l	15.0	12.8	12.0	16.5
TKN	mg/l	.69	1.79	0.81	0.90
TP	mg/l	.136	0.116	0.41	0.14
Fe.coli		185	N/A	N/A	N/A

NURP STORM VS. DRY WEATHER SAMPLING

Exhibit 29

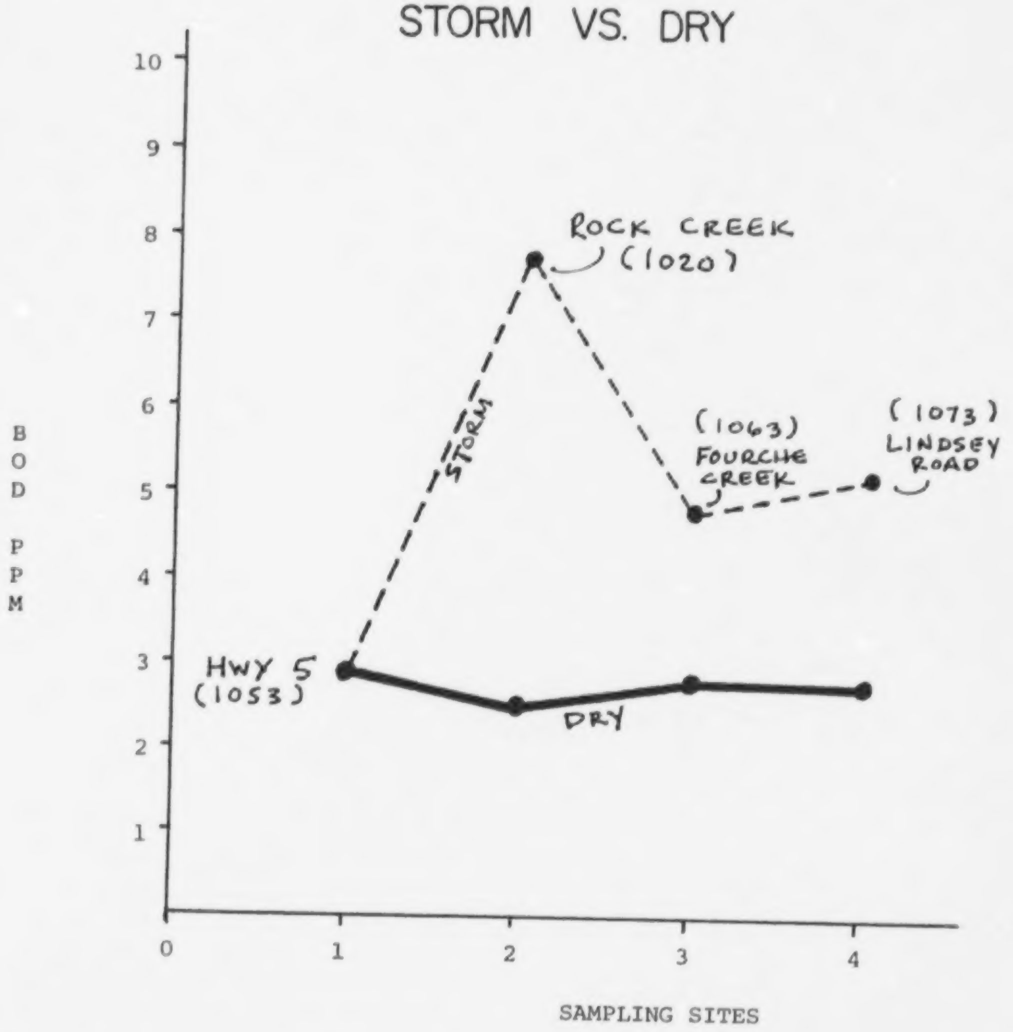
RAINFALL EVENTS

	Amount	Duration
10/17/80	2.43	8 hrs. 44 min.
10/27/80	.80	13 hrs. 45 min.
11/14/80	3.32	19 hrs. 10 min.
12/ 8/80	1.73	14 hrs. 50 min.
1/ 6/81	.45	7 hrs. 47 min.
2/ 1/81	1.24	13 hrs. 20 min.
2/10/81	.79	9 hrs. 15 min.
2/28/81	1.52	17 hrs. 5 min.
3/21/81	1.79	16 hrs. 17 min.
4/18/81	.29	1 hrs. 58 min.
5/17/81	2.16	9 hrs. 30 min.
5/25/81	1.89	5 hrs. 46 min.
6/ 3/81	.92	3 hrs. 50 min.
6/30/81	2.15	7 hrs. 03 min.
10/23/81	2.08	19 hrs. 4 min.
11/22/81	.1	-
1/ 2/82	.62	12 hrs. 20 min.
1/22/82	2.35	2 hrs. 24 min.
1/29/82	.63	4 hrs. 42 min.
2/ 8/82	.83	6 hrs. 35 min.
2/16/82	.82	3 hrs. 55 min.
3/14/82	2.04	6 hrs. 49 min.
4/ 1/82	.09	1 hrs. 30 min.
4/ 2/82	4.44	19 hrs. 38 min.
4/18/82	.74	16 hrs. 33 min.
5/ 6/82	2.15	8 hrs. 47 min.
5/19/82	.96	2 hrs. 00 min.
10/28/82	1.04	4 hrs. 55 min.
11/19/82	1.29	15 hrs. 34 min.

NURP PRECIPITATION AND DURATION STORM EVENTS

Exhibit 30

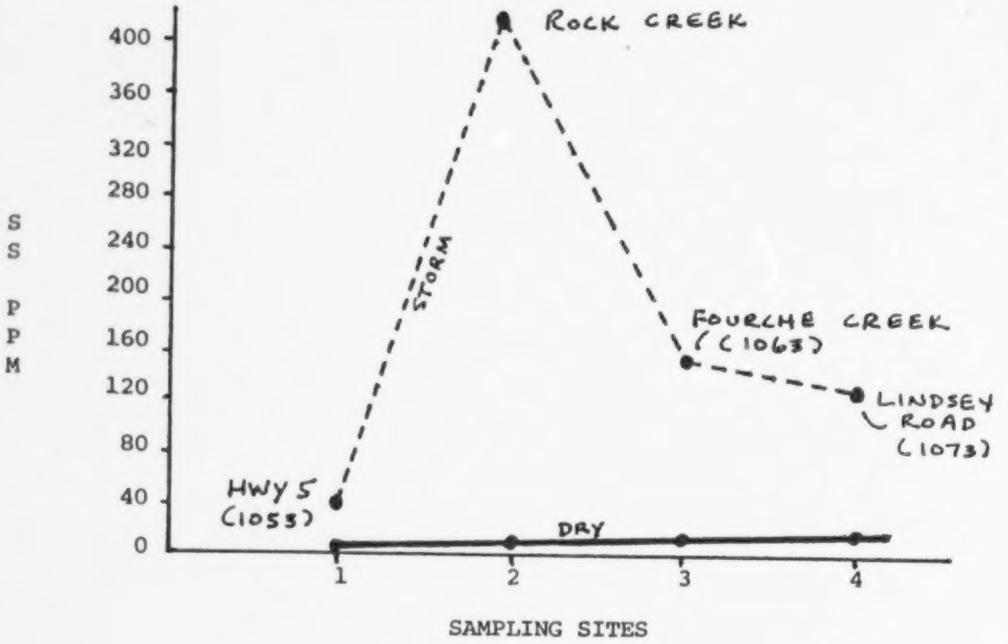
Exhibit 31-A



STORM VS. DRY
B O D P P M
10
9
8
7
6
5
4
3
2
1
0
1
2
3
4
SAMPLING SITES
ROCK CREEK (1020)
(1063) FOURCHE CREEK
(1073) LINDSEY ROAD
HWY 5 (1053)
STORM
DRY

Exhibit 31-B

STORM VS. DRY



STORM VS. DRY

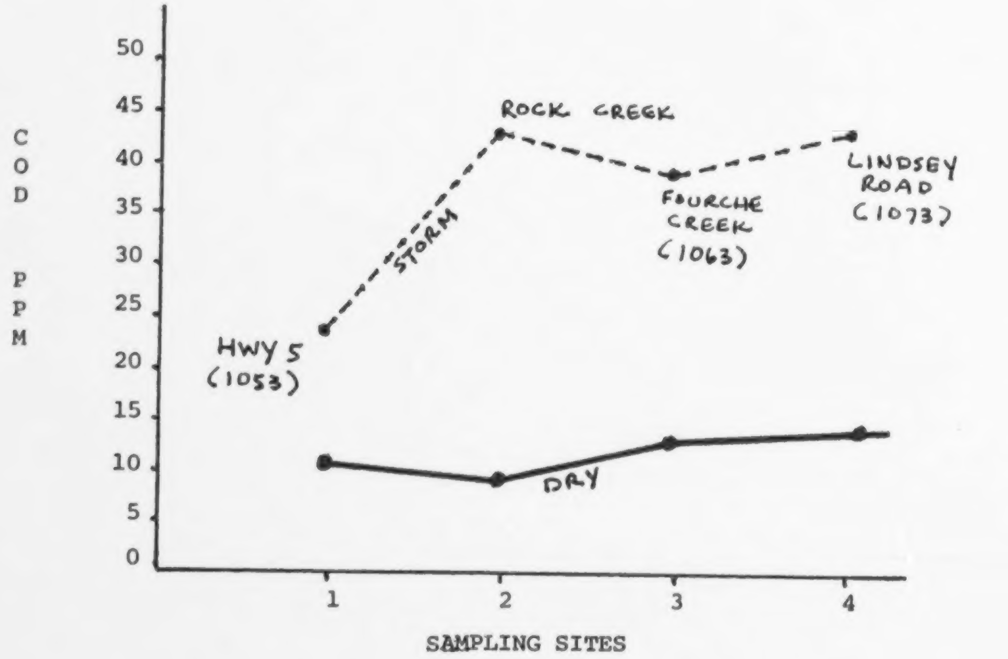
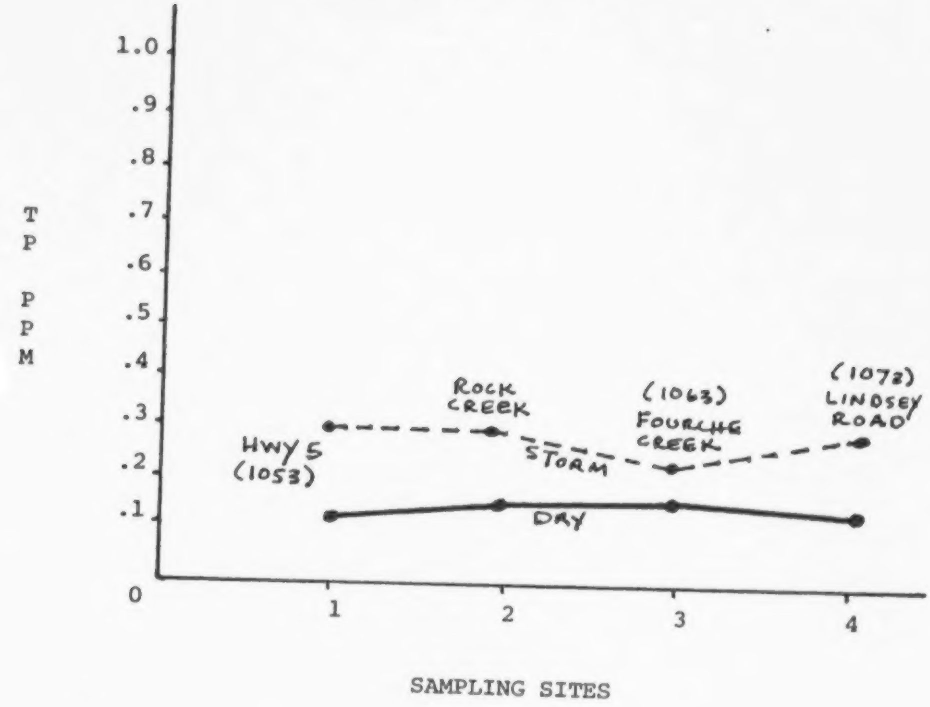
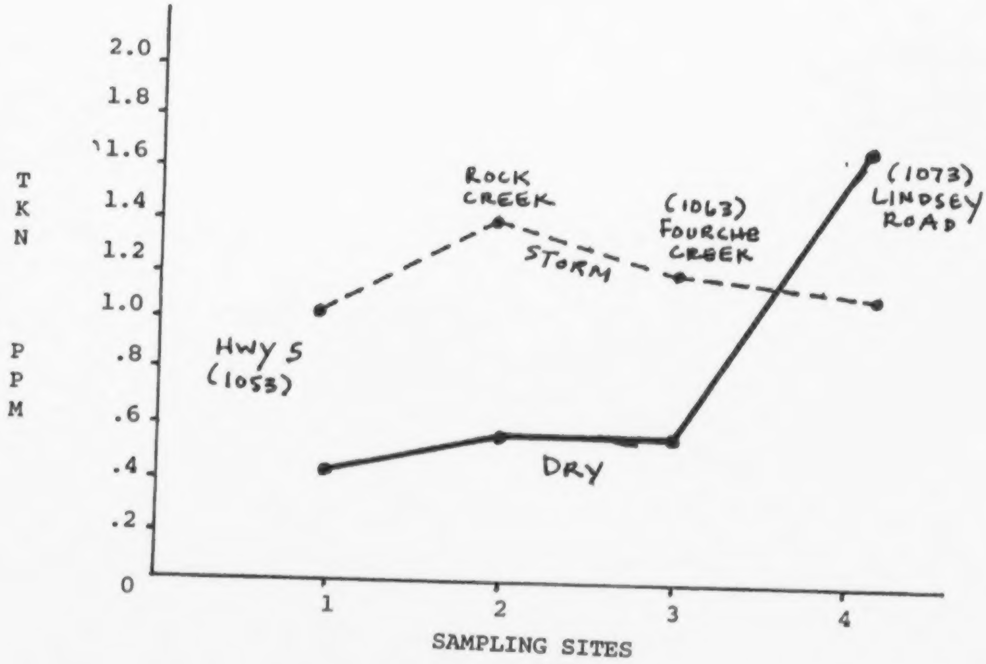


Exhibit 31-C

STORM VS. DRY



STORM VS. DRY



IV. BEST MANAGEMENT PRACTICE (BMP) EVALUATION

Work completed during the first year of the project included land use and land cover mapping of the urban area draining to Fourche Creek and its tributaries and a first year sampling program identifying stormwater generated water quality problems through data and pollutant load calculations.

After a period of extensive review and preventive approaches to stormwater management, several practical Best Management Practices were selected to be implemented and evaluated during the second year of the project. These were selected by Metroplan in agreement with EPA and the City of Little Rock. These include bank stabilization on Grassy Flat Creek were gabions were placed, sodding and catch basins at War Memorial Park and bank stabilization and channel improvements on Rock Creek. These BMPs were installed by the City of Little Rock Departments of Public Works and Parks and Recreation.

The BMPs were completed at all sites by June 1982. They were located along streams which are tributaries to Fourche Creek and were designed for integration with city parks. The strategy for the evaluation phase of the project was to provide data which illustrated the effect that the existing park system has upon the water quality of Fourche Creek and its tributaries.

Based upon first year sampling results, the City of Little Rock Parks Department prepared and posted signs which notify the public that water in the Fourche System is unsuitable for contact recreation. These signs were installed during the last quarter of the second year of the NURP project and were located where water has been found to contain high coliform levels.

Strategy for BMP Evaluation

During the 2nd year effort of the Little Rock NURP project, Metroplan began a series of sampling designed to evaluate the effectiveness of the Best Management Practices identified in the Fourche Creek NURP Execution Plan.

The basis for selecting the BMP's was the utilization of drainage systems and their modifications in conjunction with the park system to attempt to develop a series of BMP's which could improve water quality from Urban Runoff. The program focused on Rock Creek, Grassy Flat Creek and Coleman Creek, all major tributaries of Fourche Creek.

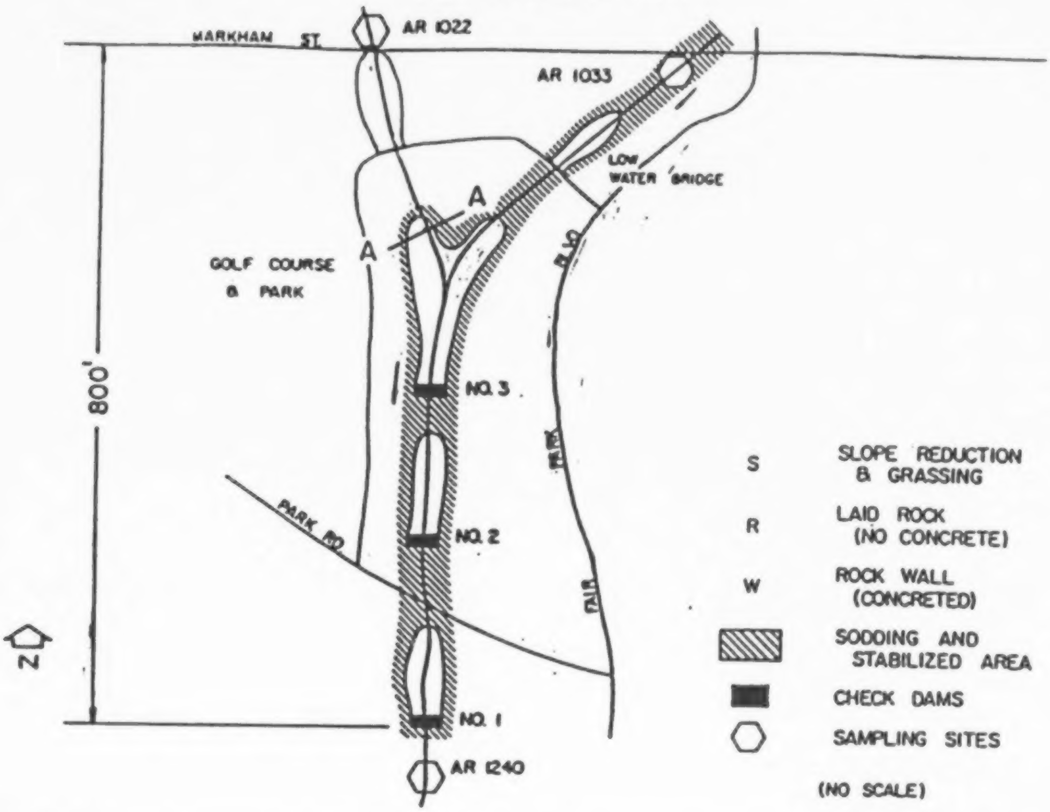
Illustrated in Exhibit 28 are the locations of the BMP's and the new sampling sites selected to evaluate them. The BMP's were located with the assistance of the City of Little Rock and were chosen during several field trips and meetings. The BMP's were grouped along streams which are tributaries to Fourche Creek. The strategy included the use of retention ponds, grassed water courses, rip rapped and stabilized banks.

Coleman Creek

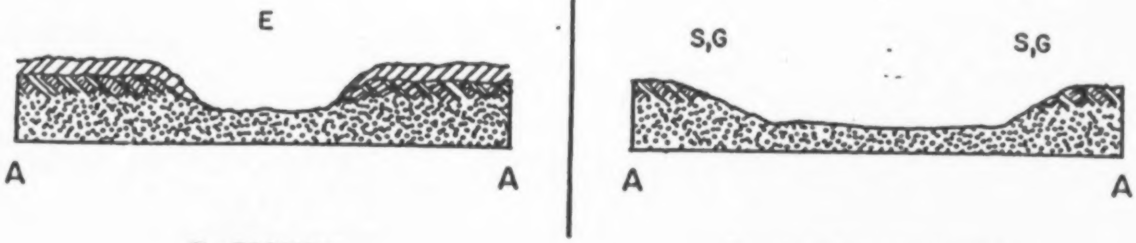
War Memorial Park was the location of the installation of a series of BMP's. In cooperation with the City of Little Rock Parks Department, a series of small check dams was constructed

SODDING AND CATCH BASINS

WAR MEMORIAL PARK


MARKHAM ST.
AR 1022
AR 1033
LOW WATER BRIDGE
A
A
GOLF COURSE & PARK
800'
NO. 3
NO. 2
NO. 1
PARK RD
FAIR PARK BLVD
N
AR 1240
S SLOPE REDUCTION & GRASSING
R LAID ROCK (NO CONCRETE)
W ROCK WALL (CONCRETED)
SODDING AND STABILIZED AREA
CHECK DAMS
SAMPLING SITES
(NO SCALE)

CREEK SECTION A-A



BEFORE IMPROVEMENTS

E = EROSION

AFTER IMPROVEMENTS

S = SLOPE REDUCTION
G = GRASSING

Exhibit 32

Exhibit 33

Table 1-A

Summary of Storm Event
Coleman Creek

January 2, 1982

	AR 1033 RB	AR 1022 LB	AR 1240 DS	Reduction (lbs)	Reduction %
BOD	1,814	454	1,641	627	28%
SS	17,291	11,358	27,586	1,063	4%
TN	237	81	252	66	21%
TP	100	41	81	60	43%
VOL (MG)	23.58	5.04	16.5		42%

Table 1-B

Coleman Creek

November 11, 1981

BOD	1,250	332	885	697	44%
SS	42,025	14,407	33,509	22,923	41%
TN	353	108	247	214	46%
TP	98	48	102	44	30%
VOL	16.53	5.59	14.26		36%

AR 1033 - Right branch of Coleman Creek upstream of BMP

AR 1022 - Left branch of Coleman Creek upstream of BMP

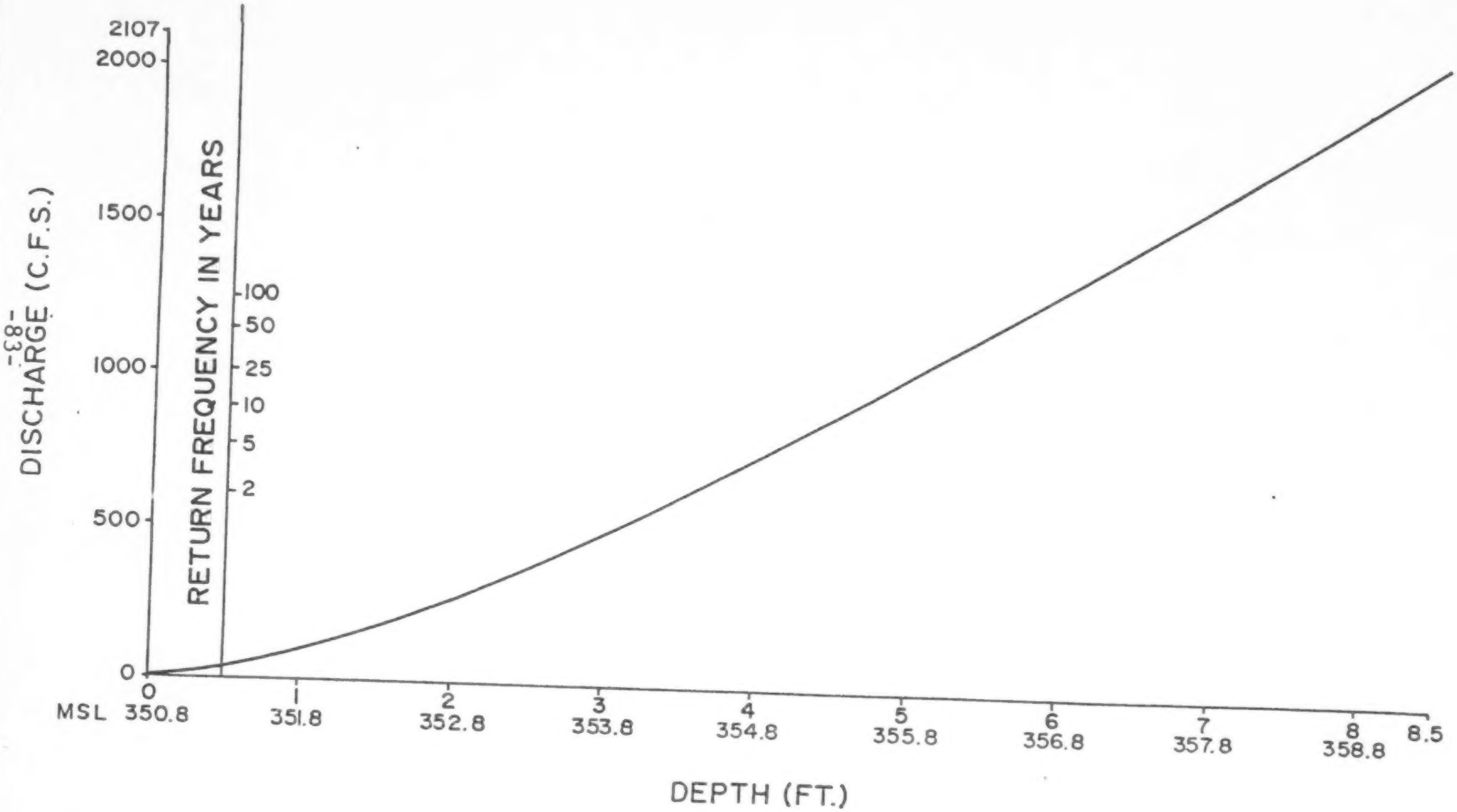
AR 1240 - Downstream of BMP's Coleman Creek

Exhibit 33 (cont'd)
Table 1-C

Coleman Creek

October 23, 1981

	AR 1033 RB	AR 1022 LB	AR 1240 DS	Reduction (lbs)	Reduction %
BOD	1,913	50	1,388	575	29%
SS	10,806	576	13,273	-1,792	-16%
TN	428	11	253	186	42%
TP	121	3	81	43	35%
VOL (MG)	40.18	1.16	29		30%



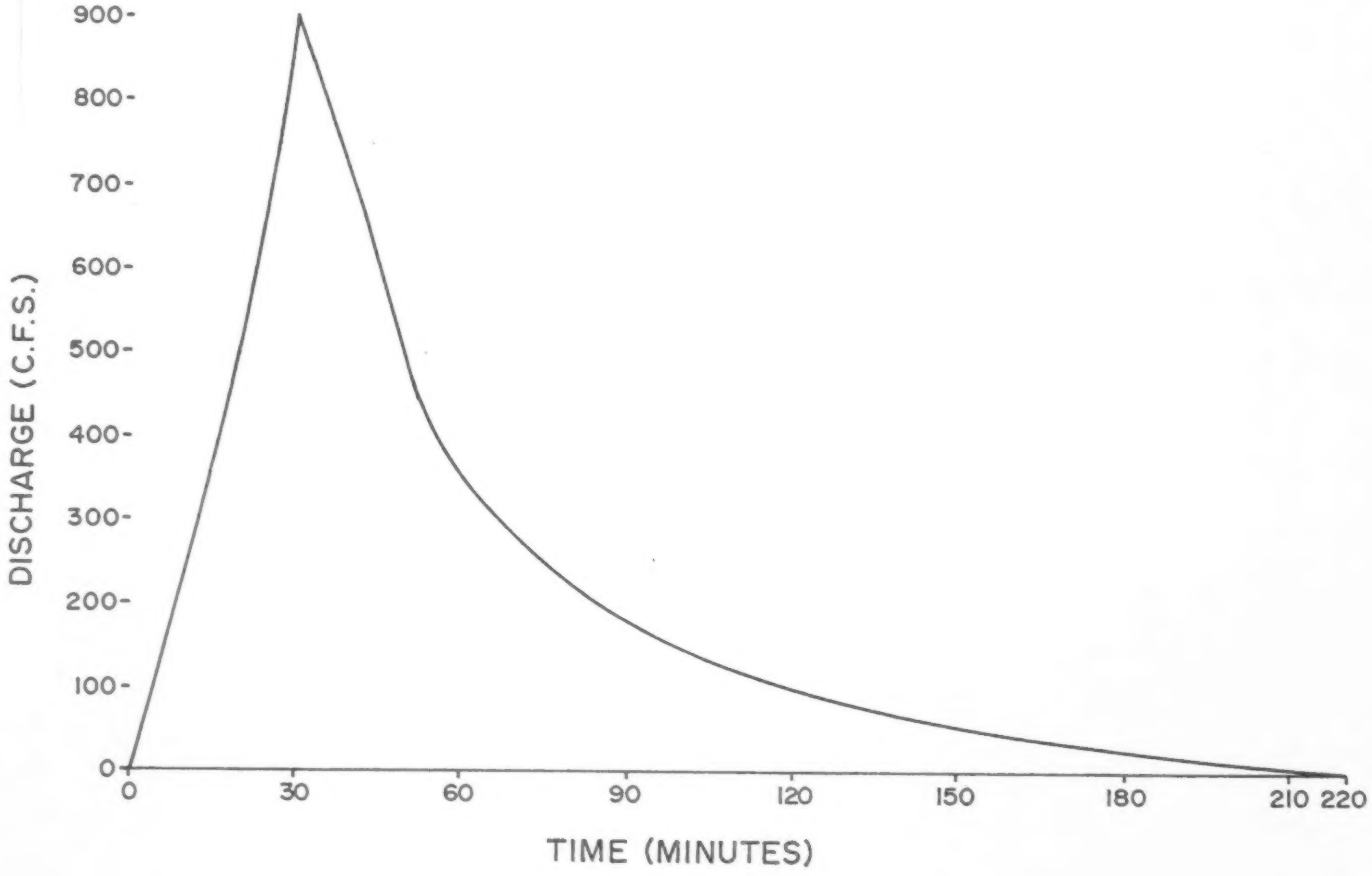
AR 1022
COLEMAN CREEK
WEST BRANCH
AT WAR MEMORIAL PARK

Exhibit 34-A

TEAFORD ENGINEERING ASSOC., INC.

MARCH 1982

SUMMERLIN ASSOC., INC.



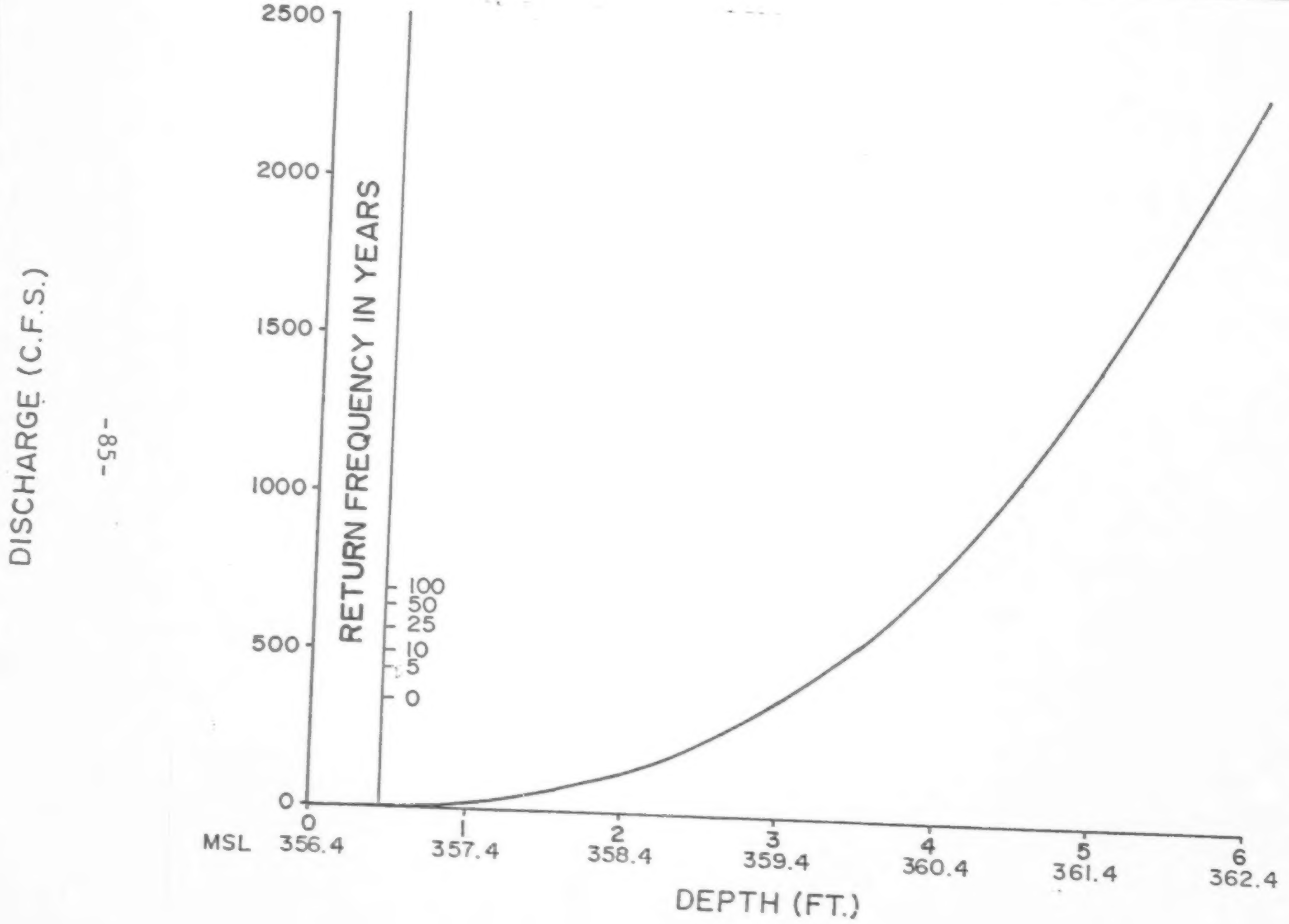
AR 1022
COLEMAN CREEK
WEST BRANCH
AT WAR MEMORIAL PARK

Exhibit 34-B

TEAFORD ENGINEERING ASSOC., INC.

MARCH 1982

SUMMERLIN ASSOC., INC.



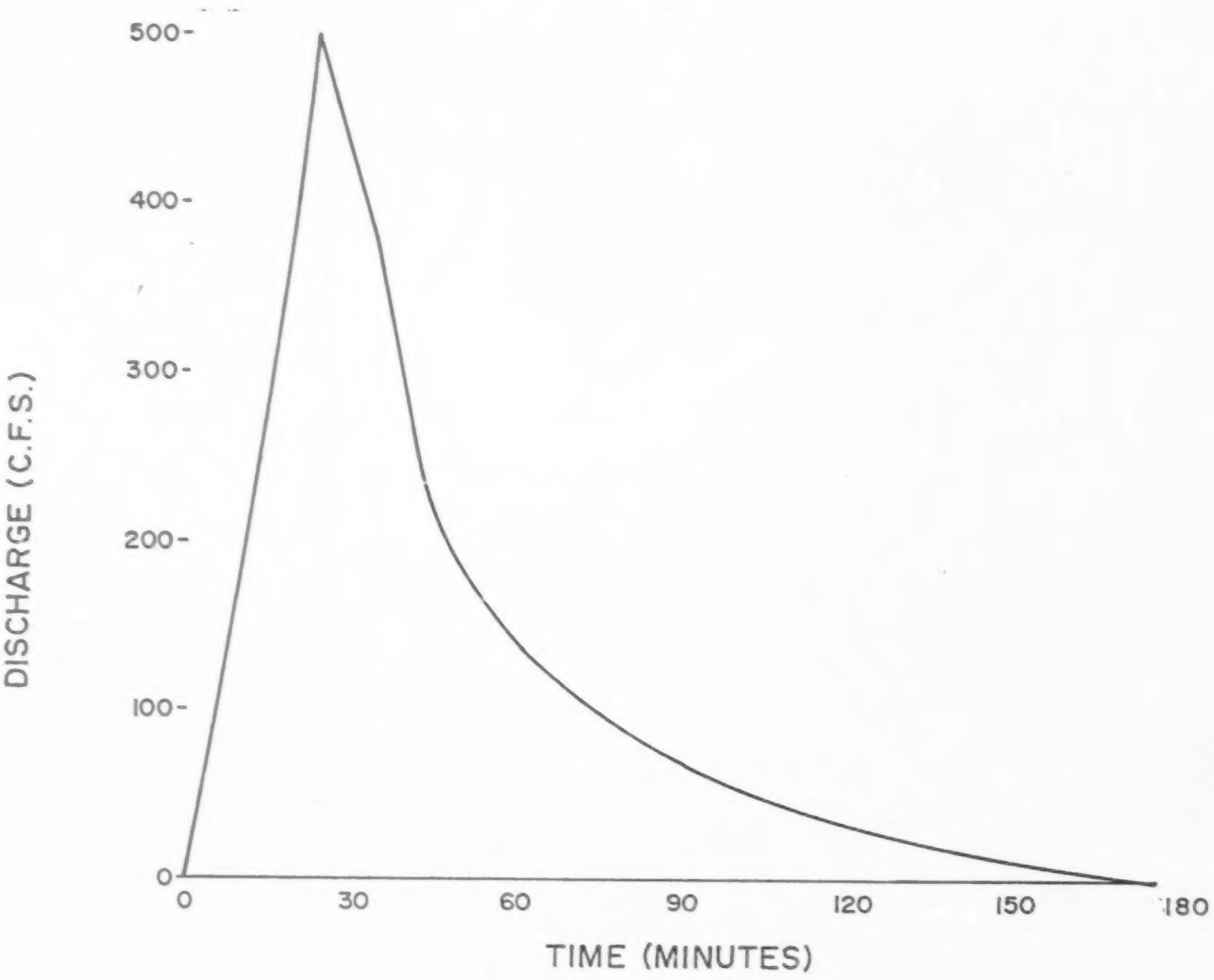
AR 1033
COLEMAN CREEK
EAST BRANCH
AT WAR MEMORIAL PARK

Exhibit 34-C

TEAFORD ENGINEERING ASSOC., INC.

MARCH 1982

SUMMERLIN ASSOC., INC.



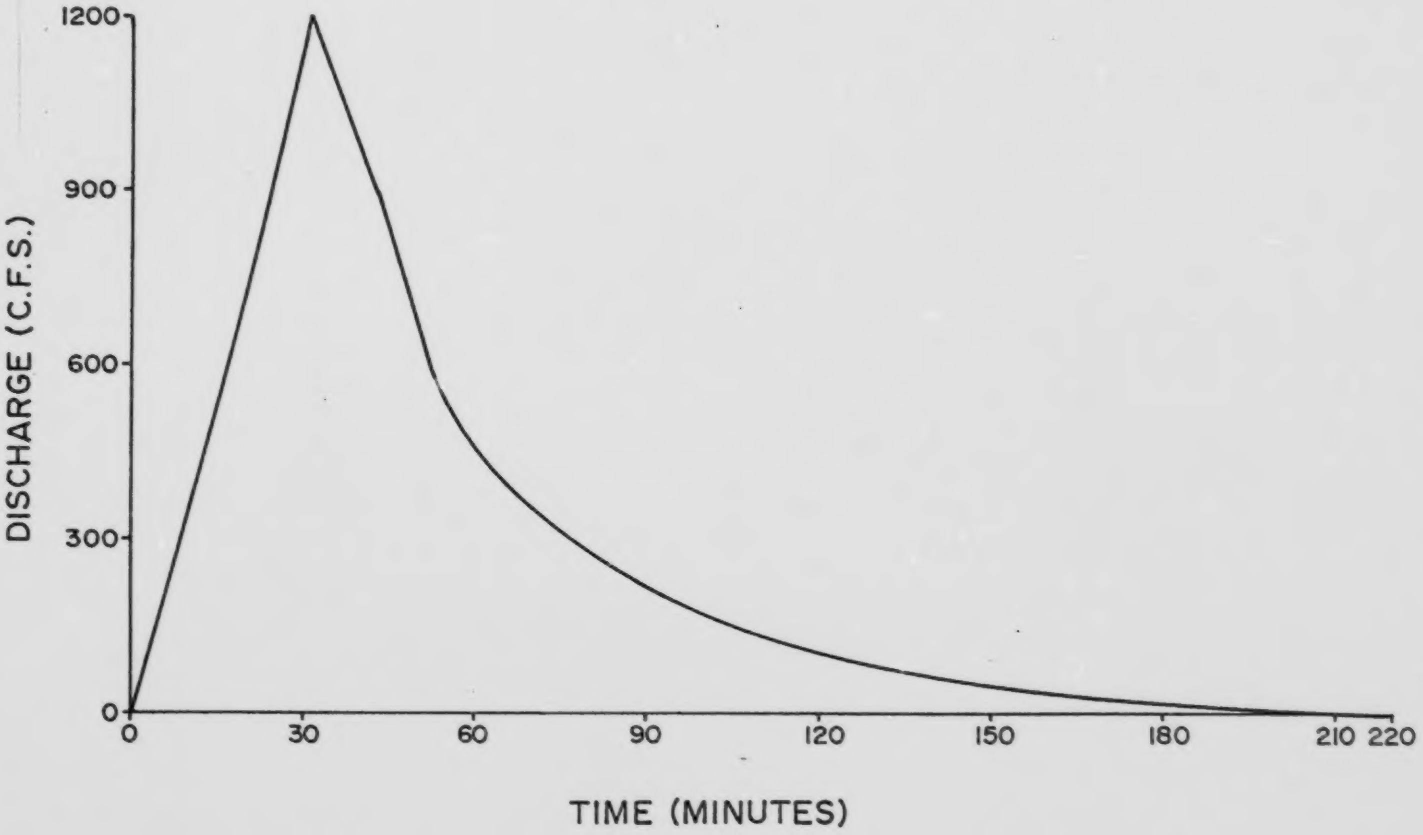
AR 1033
COLEMAN CREEK
EAST BRANCH
AT WAR MEMORIAL PARK

Exhibit 34-D

TEAFORD ENGINEERING ASSOC., INC.

MARCH 1982

SUMMERLIN ASSOC., INC.



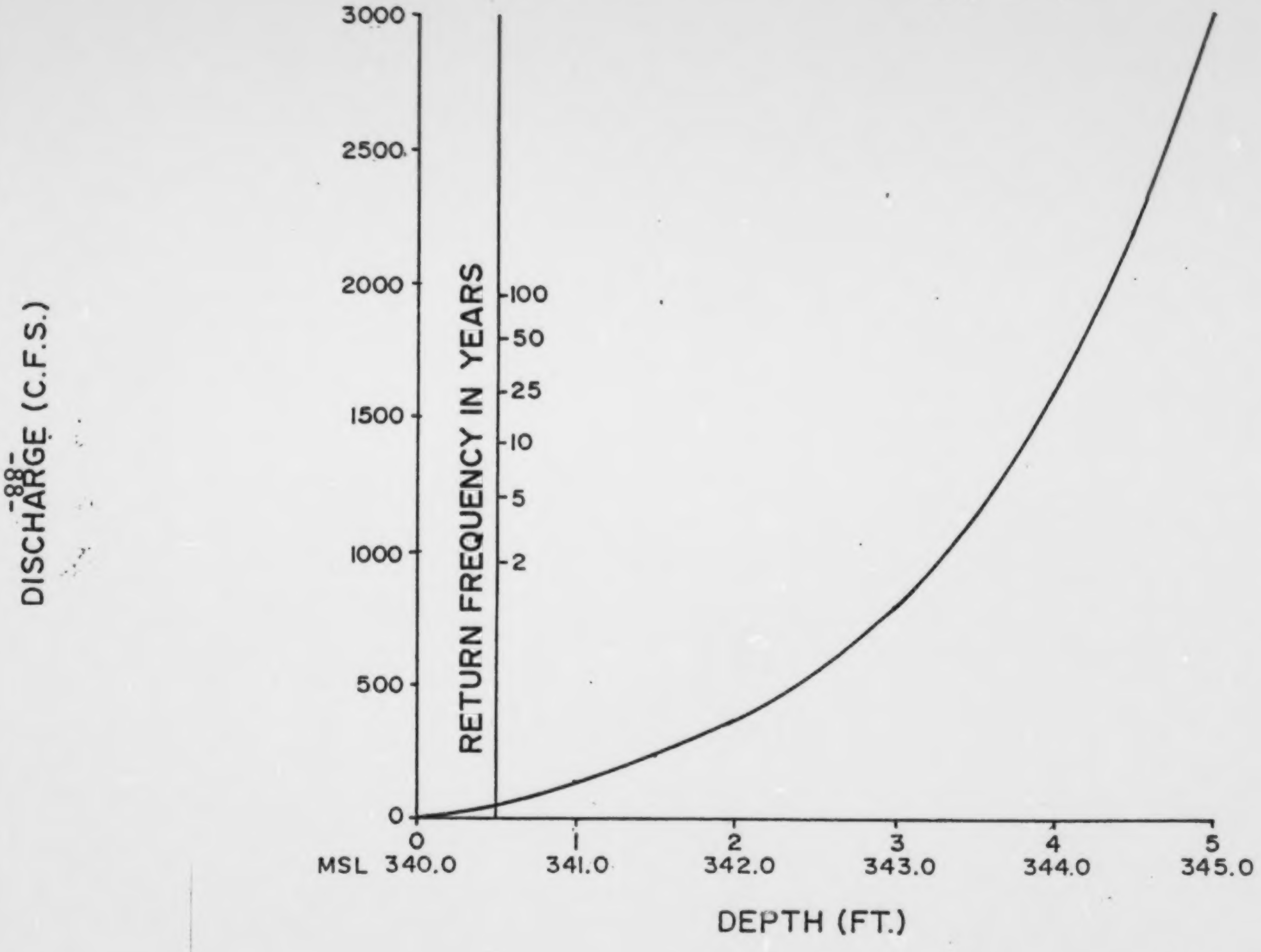
AR 1240
COLEMAN CREEK
DOWNSTREAM OF BMP
WAR MEMORIAL PARK

Exhibit 34-E

TEAFORD ENGINEERING ASSOC., INC.

MARCH 1982

SUMMERLIN ASSOC., INC.



AR 1240
COLEMAN CREEK
DOWNSTREAM OF BMP
WAR MEMORIAL PARK

Exhibit 34-F

TEAFORD ENGINEERING ASSOC., INC.

MARCH 1982

SUMMERLIN ASSOC., INC.

on Coleman Creek as it traversed the Park. In addition the banks of the creek were stabilized using grass sod (see Exhibit 32-1).

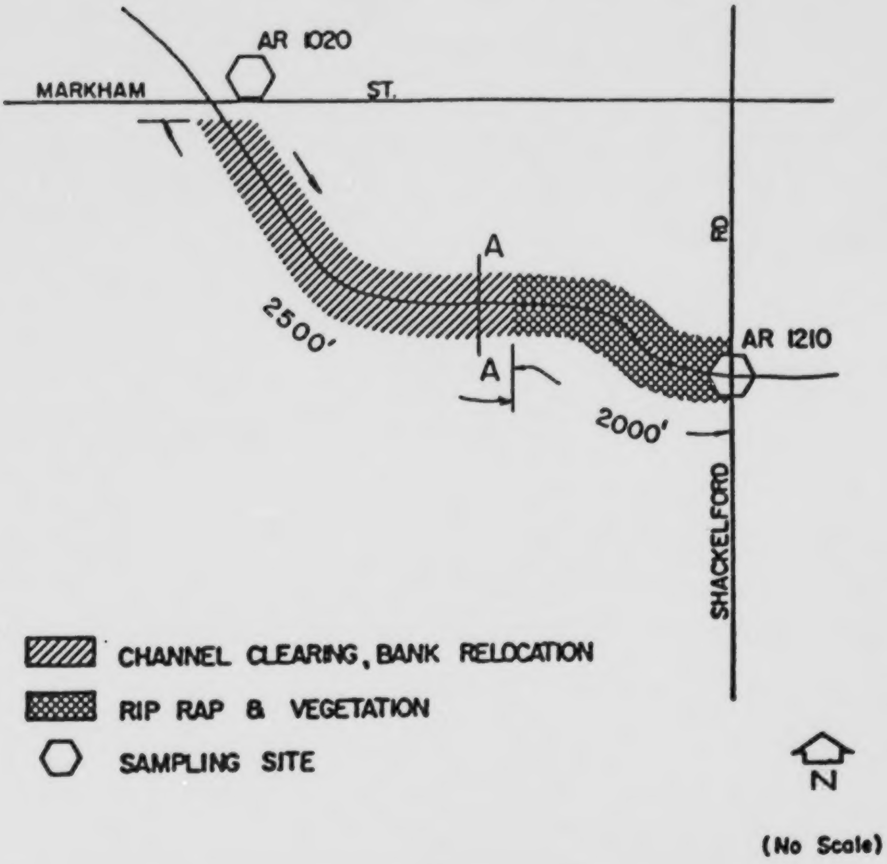
Information from 3 storm events are summarized in Tables 1-A, 1-B, and 1-C (Exhibit 33). These tables illustrate the reduction in loading which occurred as a result of the installation of the BMP's. The data for these tables are found in Volume II, The Data Report. Findings indicated that the peak discharge has been dampened as well as the pollution load which results. In order to tie the water data into a command basis a series of frequency/stage curves were developed for the site (Exhibit 34). This information was helpful in determining a basis for treatment of urban stormwater.

Rock Creek

Rock Creek, a major tributary of Fourche Creek, traverses through a major part of the Little Rock Parks System. In addition its land use is varied. On the upper urban fringe the BMP's constructed in the creek included the sideslope flattened and sodded. Some main stem straightening and widening and rip rap of side channels was involved. This allowed the creek to have "incline" storage and also allowed the velocity to be reduced and stabilized the stream bed (see Exhibit 35).

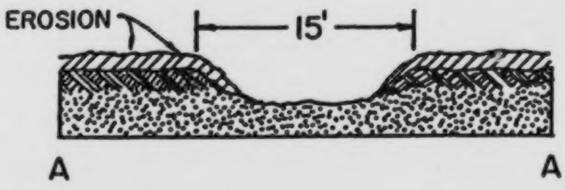
In addition, on Rock Creek a sampling program was undertaken to follow a storm event down the creek. The results of this event are illustrated in Tables 2-5 (Exhibit 36). Table 2 is a composite of the January 22, 1982 event. It showed the load of BOD, SS, TN and TP which passed each station beginning upstream at Markham Road

STABILIZATION OF ROCK CREEK


AR 1020
MARKHAM
ST.
A
RD
2500'
AR 1210
A
2000'
SHACKELFORD
▨ CHANNEL CLEARING, BANK RELOCATION
▩ RIP RAP & VEGETATION
⬡ SAMPLING SITE
N
(No Scale)

CREEK SECTION A-A

BEFORE IMPROVEMENTS


EROSION
15'
A
A

AFTER IMPROVEMENTS

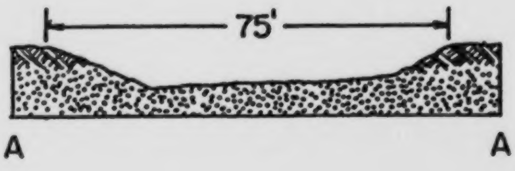


Exhibit 35

JAN 22,1982 ROCK CREEK	BOD LBS & MG/L	S.S. LBS & MG/L	TN. LBS & MG/L	TP. LBS & MG/L	VOLUME M.G.	TIME(HRS)
MARKHAM RD (1020)	1838.50	97097.00	538.15	135.61	63.85	20.25
	3.45	182.34	1.01	0.25		
LBS/HOUR--	90.79	4794.91	26.58	6.70		
SHACKELFORD (1210)	1345.10	65472.00	388.28	94.20	38.98	19.38
	4.14	201.39	1.19	0.29		
LBS/HOUR--	69.41	3378.33	20.04	4.86		
I-630 (1310)	2369.90	148097.00	606.41	144.20	63.52	19.42
	4.47	279.56	1.14	0.27		
LBS/HOUR--	122.03	7626.00	31.23	7.43		
BOYLE PARK (1220)	3141.90	249942.00	1150.70	247.10	93.82	20.50
	4.02	319.43	1.47	0.32		
LBS/HOUR--	153.26	12192.29	56.13	12.05		
36TH ST. (1040)	4342.40	260814.00	1371.60	250.78	122.04	19.95
	4.27	256.25	1.35	0.25		
LBS/HOUR--	217.66	13073.38	68.75	12.57		

Total Storm Value

Table 2

Exhibit 36-A

JAN 22,1982	BOD	S.S.	TN.	TP.	VOLUME	TIME(HRS)
ROCK CREEK	LBS & MG/L	LBS & MG/L	LBS & MG/L	LBS & MG/L	M.G.	
MARKHAM RD	137.24	10455.00	38.55	5.88	3.91	1.62
(1020)	4.21	320.61	1.18	0.18		
LBS/HOUR--	84.72	6453.70	23.80	3.63		
SHACKELFORD	71.58	3106.00	15.51	3.18	1.90	1.42
(1210)	4.52	196.01	0.98	0.20		
LBS/HOUR--	50.41	2187.32	10.92	2.24		
I-630	104.74	10539.00	15.33	5.68	1.79	1.08
(1310)	7.02	705.96	1.03	0.38		
LBS/HOUR--	96.98	9758.33	14.19	5.26		
BOYLE PARK	52.25	2266.70	13.83	2.21	1.47	0.75
(1210)	4.26	184.89	1.13	0.18		
LBS/HOUR--	69.67	3022.27	18.44	2.95		
36TH ST.	32.61	330.08	7.31	1.07	0.95	0.42
(1040)	4.12	41.66	0.92	0.14		
LBS/HOUR--	77.64	785.90	17.40	2.55		

First Increment Value

Table 3

Exhibit 36-B

JAN 22,1982	BOD	S.S.	TN.	TP.	VOLUME	TIME(HRS)
ROCK CREEK	LBS & MG/L	LBS & MG/L	LBS & MG/L	LBS & MG/L	M.G.	
MARKHAM RD	810.00	55926.00	265.00	69.00	24.65	4.47
(1020)	3.94	272.04	1.29	0.34		
LBS/HOUR--	181.21	12511.41	59.28	15.44		
SHACKELFORD	591.00	38315.00	183.00	47.00	15.07	4.33
(1210)	4.70	304.85	1.46	0.37		
LBS/HOUR--	136.49	8848.73	42.26	10.85		
I-630	1289.00	102846.00	297.00	73.00	25.18	4.33
(1310)	6.14	489.74	1.41	0.35		
LBS/HOUR--	297.69	23751.96	68.59	16.86		
BOYLE PARK	1399.00	185847.00	642.00	131.00	36.35	4.33
(1210)	4.61	613.03	2.12	0.43		
LBS/HOUR--	323.09	42920.79	148.27	30.25		
36TH ST.	1955.00	188939.00	761.00	147.00	47.19	4.17
((1040)	4.97	480.07	1.93	0.37		
LBS/HOUR--	468.82	45309.11	182.49	35.25		

Peak Increment Value

Table 4

Exhibit 36-C

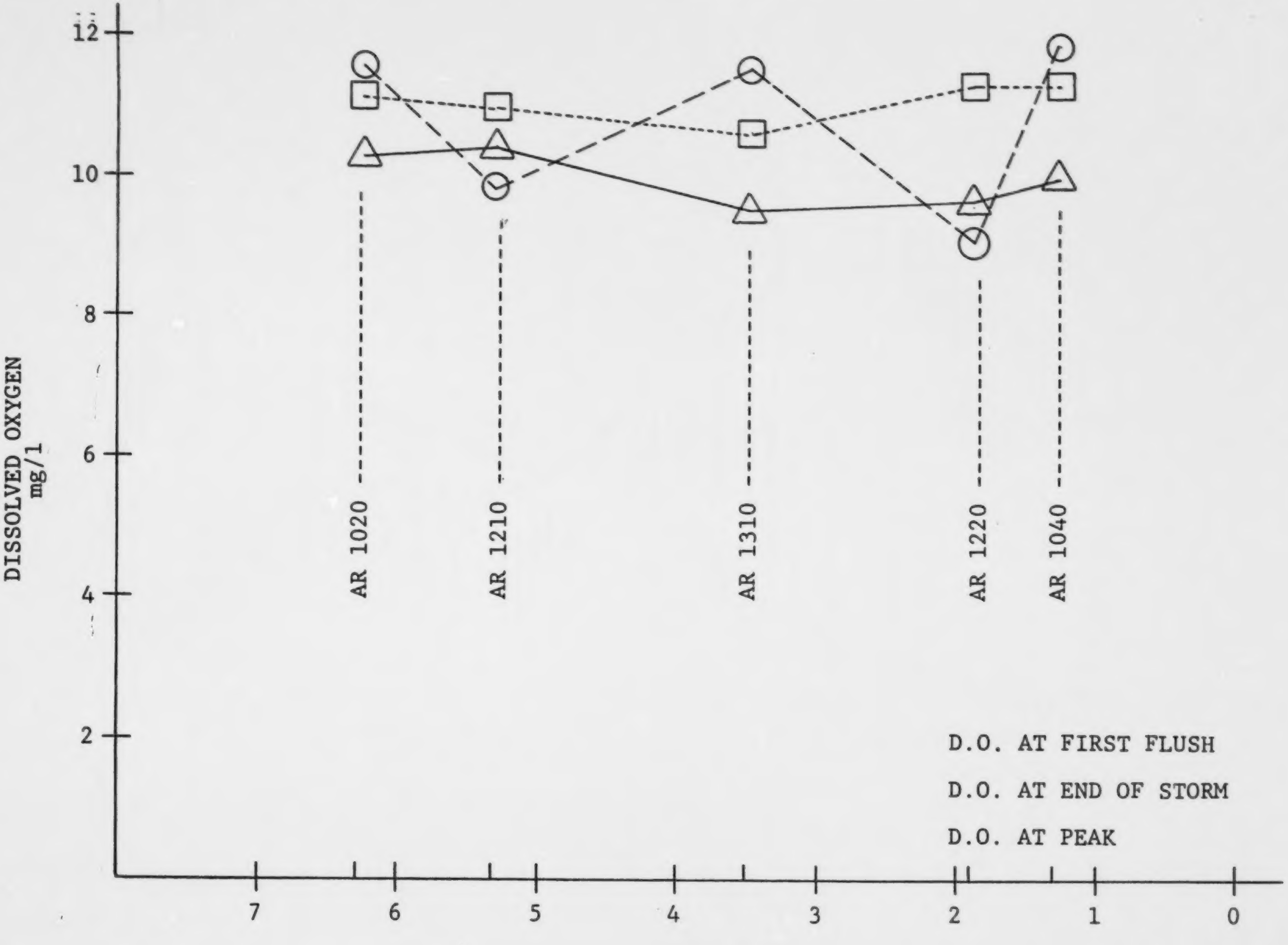
JAN 22,1982	BOD	S.S.	TN.	TP.	VOLUME	TIME(HRS)
ROCK CREEK	LBS & MG/L	LBS & MG/L	LBS & MG/L	LBS & MG/L	M.G.	
MARKHAM RD	442.00	18338.00	132.60	26.33	22.55	12.25
(1020)	2.35	97.51	0.71	0.14		
LBS/HOUR--	36.08	1496.98	10.82	2.15		
SHACKELFORD	485.29	16311.00	126.04	24.93	16.16	11.43
(1210)	3.60	121.02	0.94	0.18		
LBS/HOUR--	42.46	1427.03	11.03	2.18		
I-630	507.53	16636.00	156.96	30.07	22.53	10.33
(1310)	2.70	88.54	0.84	0.16		
LBS/HOUR--	49.13	1610.45	15.19	2.91		
BOYLE PARK	929.39	21085.00	227.49	51.32	33.26	11.33
(1210)	3.35	76.01	0.82	0.19		
LBS/HOUR--	82.03	1860.99	20.08	4.53		
36TH ST.	1115.50	19313.00	274.71	41.62	39.92	10.78
(1040)	3.35	58.01	0.83	0.13		
LBS/HOUR--	103.48	1791.56	25.48	3.86		

Last Increment Value

Table 5

Exhibit 36-D

EXHIBIT 37-A



D.O. in Rock Creek during storm January 22, 1982

EXHIBIT 37-B

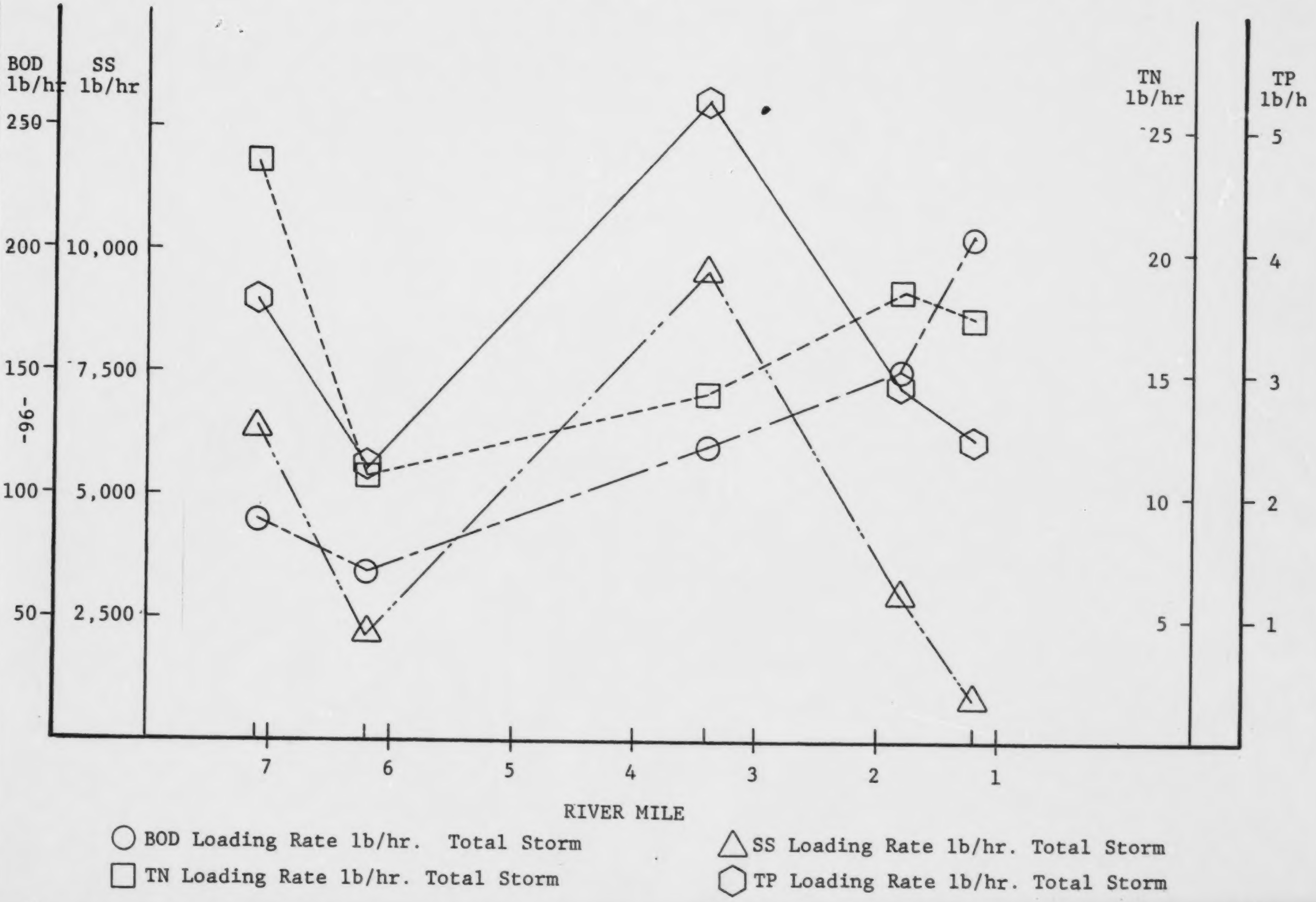
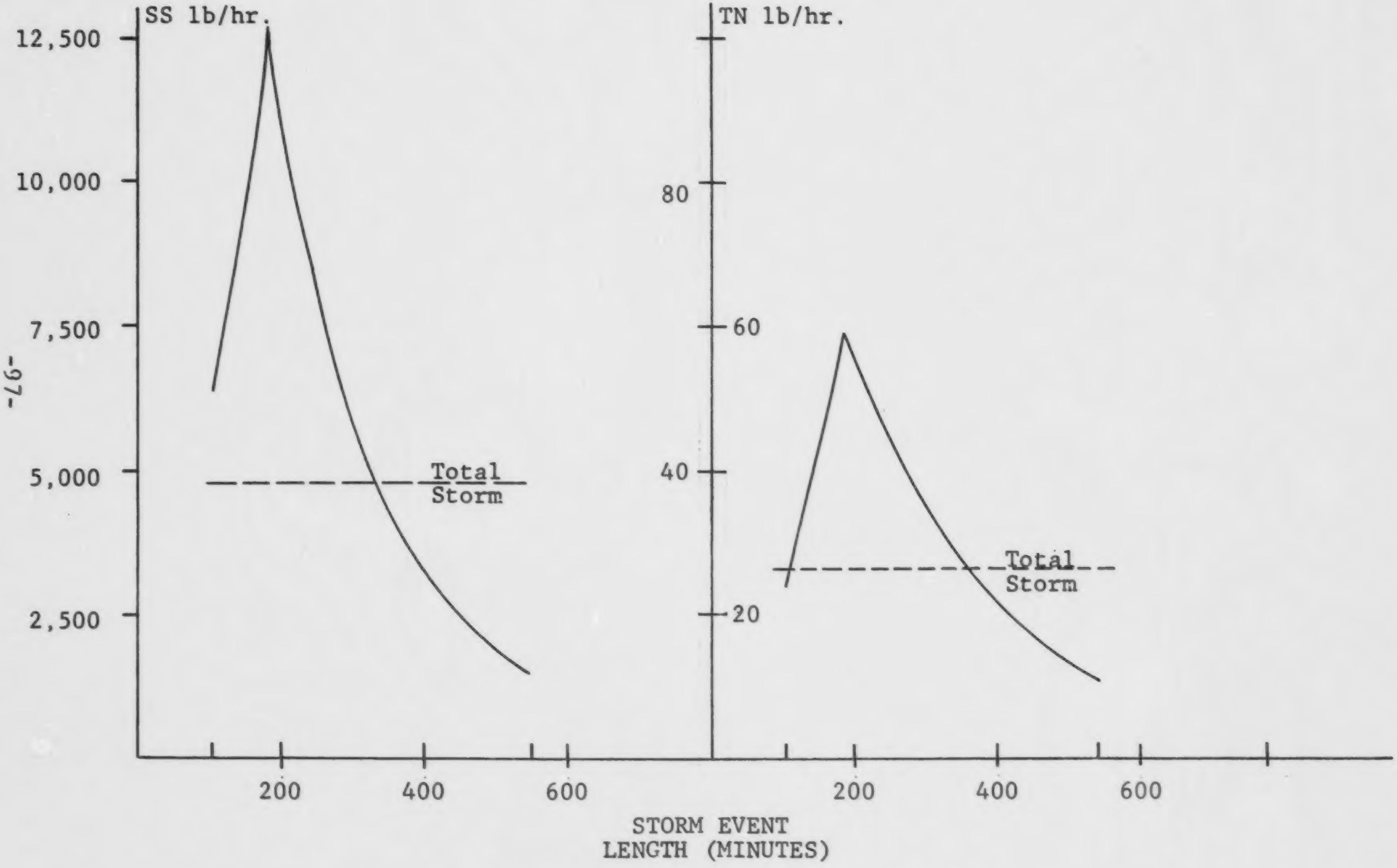
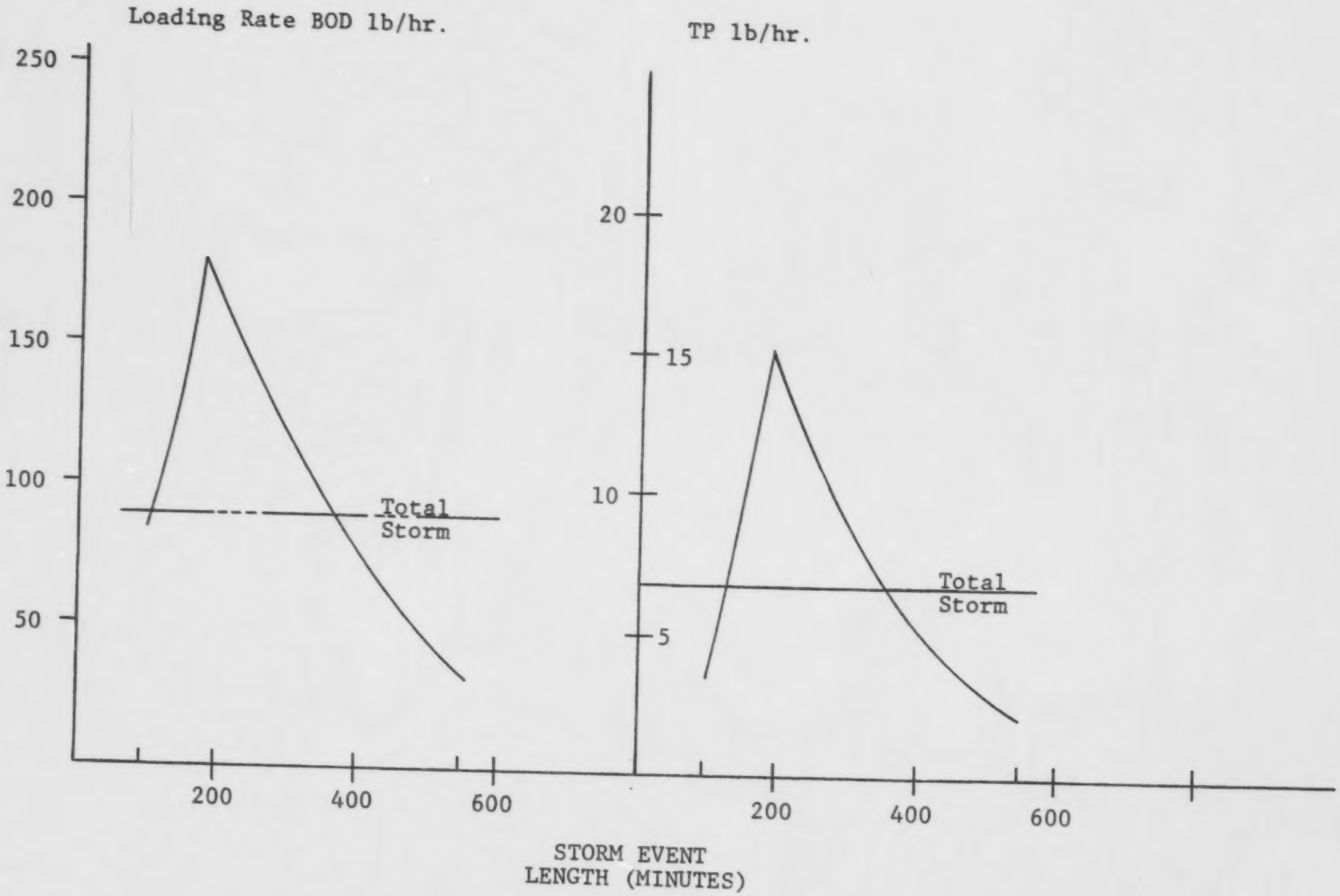

BOD
1b/hr
SS
1b/hr
250
200
150
100
50
10,000
7,500
5,000
2,500
TN
1b/hr
25
20
15
10
5
TP
1b/h
5
4
3
2
1
7
6
5
4
3
2
1
RIVER MILE
○ BOD Loading Rate 1b/hr. Total Storm
□ TN Loading Rate 1b/hr. Total Storm
△ SS Loading Rate 1b/hr. Total Storm
⬡ TP Loading Rate 1b/hr. Total Storm

EXHIBIT 37-C

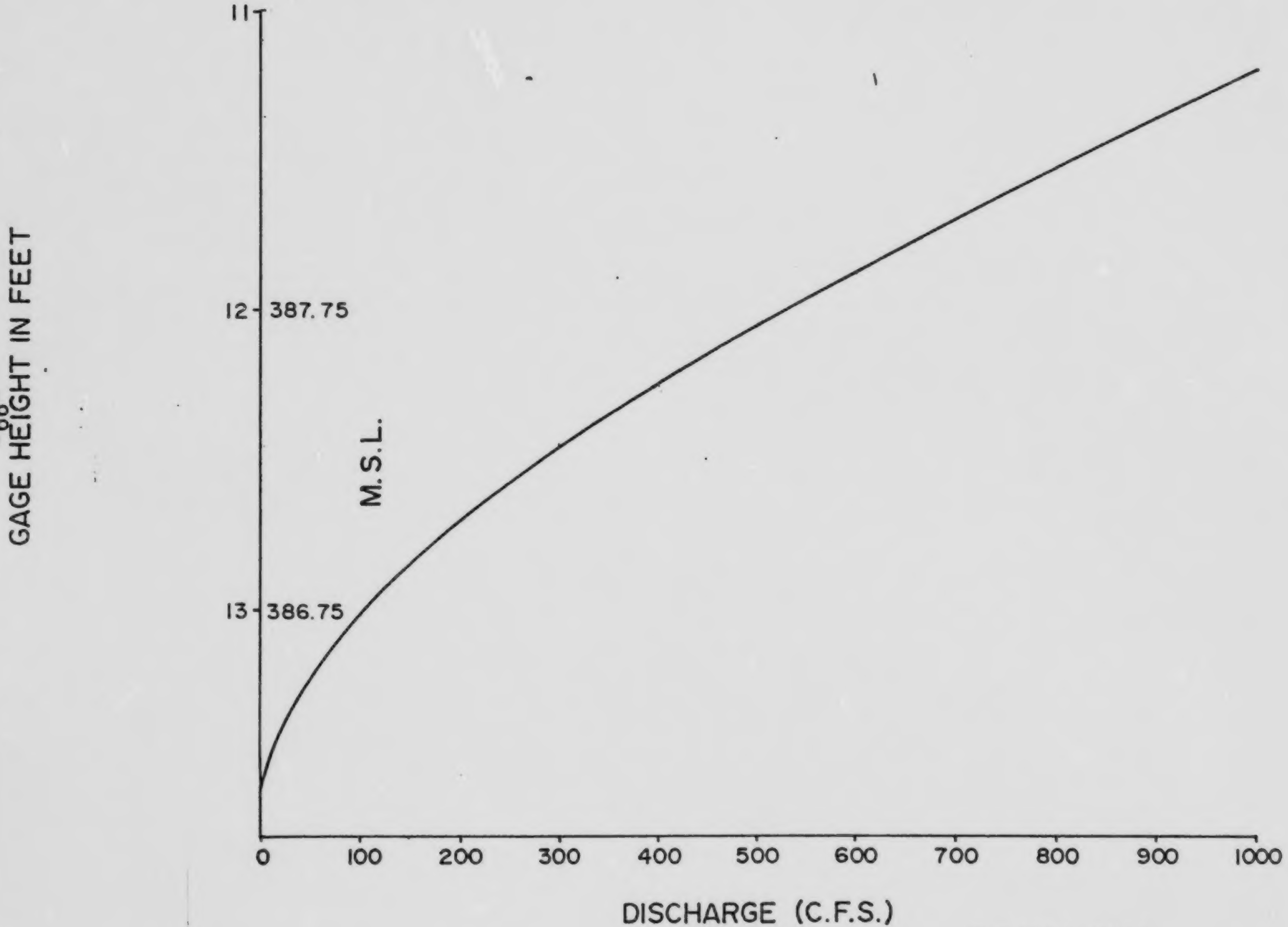


Markham Road and Rock Creek AR 1020

EXHIBIT 37-D



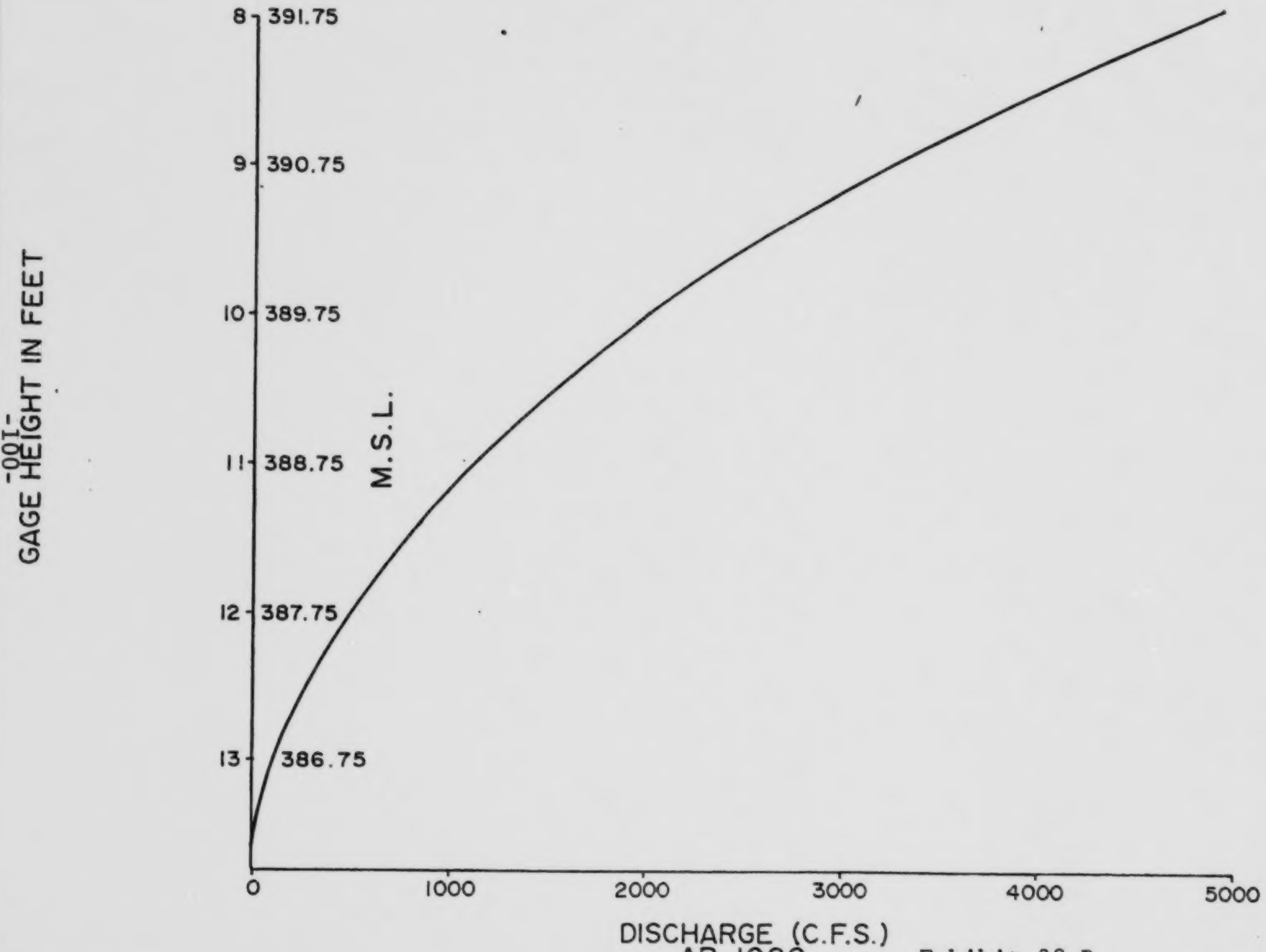
Markham Road and Rock Creek AR 1020



AR 1020
LOW WATER
ROCK CREEK AT W. MARKHAM

Exhibit 38-A

TEAFORD ENGINEERING ASSOC., INC. MARCH 1982 SUMMERLIN ASSOC., INC.



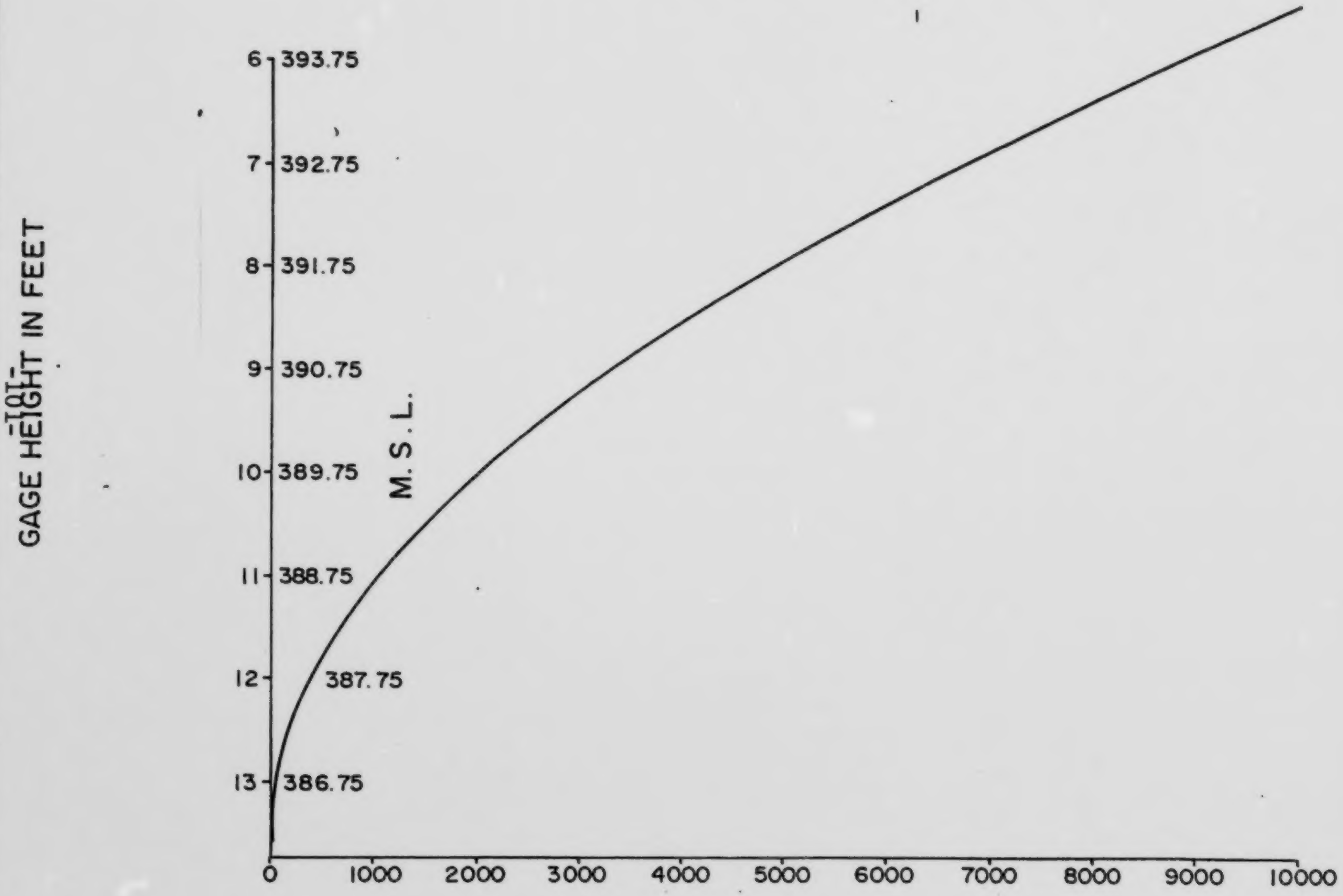
AR 1020
HIGH WATER
ROCK CREEK AT W. MARKHAM

Exhibit 38-B

TEAFORD ENGINEERING ASSOC., INC.

MARCH 1982

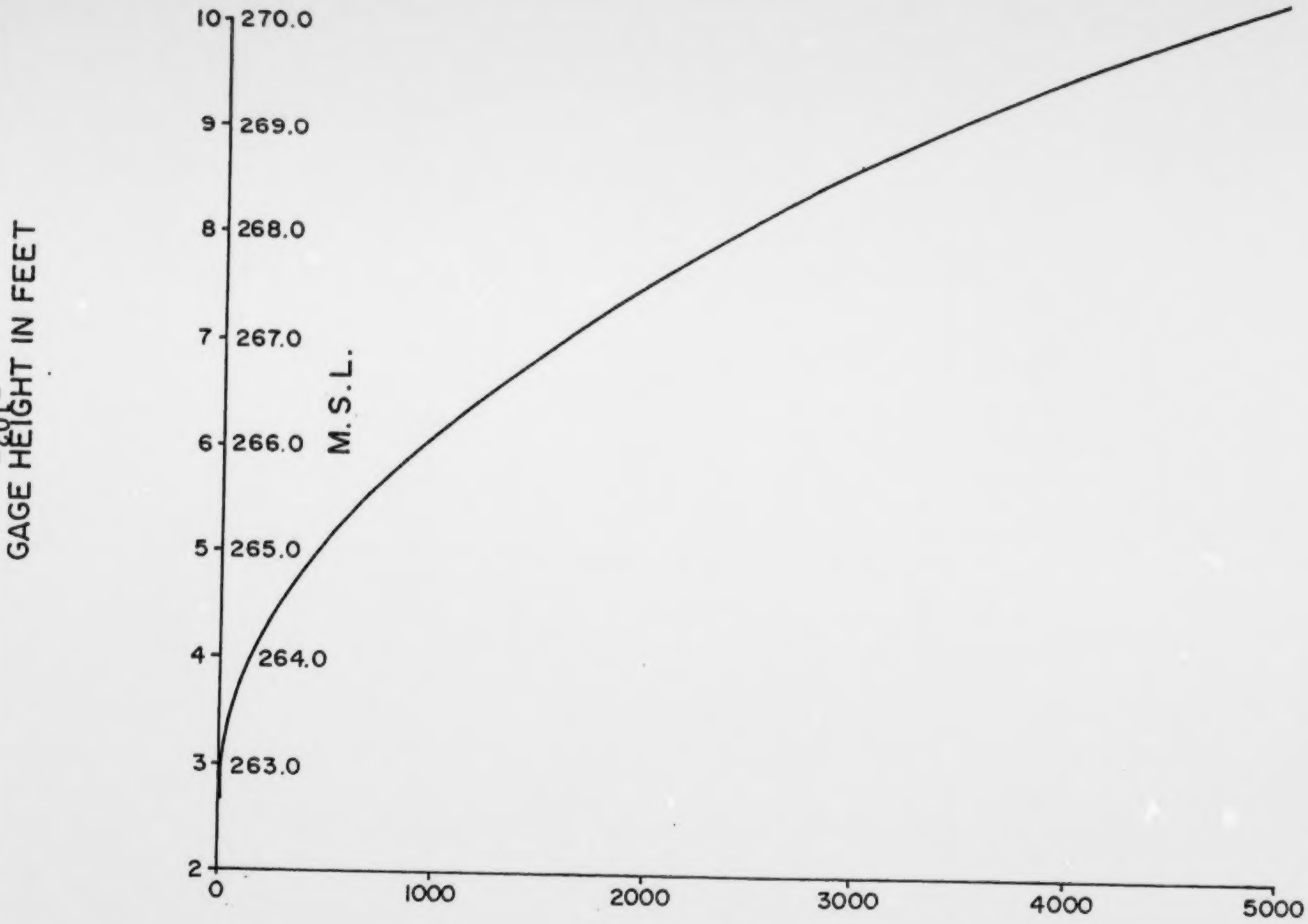
SUMMERLIN ASSOC., INC.



AR 1020
EXTREME HIGH WATER
ROCK CREEK AT W. MARKHAM

Exhibit 38-C

TEAFORD ENGINEERING ASSOC., INC. MARCH 1982 SUMMERLIN ASSOC., INC.



DISCHARGE (C.F.S.)
AR 1040
HIGH WATER
ROCK CREEK AT W. 36TH

Exhibit 38-D

TEAFORD ENGINEERING ASSOC., INC.

MARCH 1982

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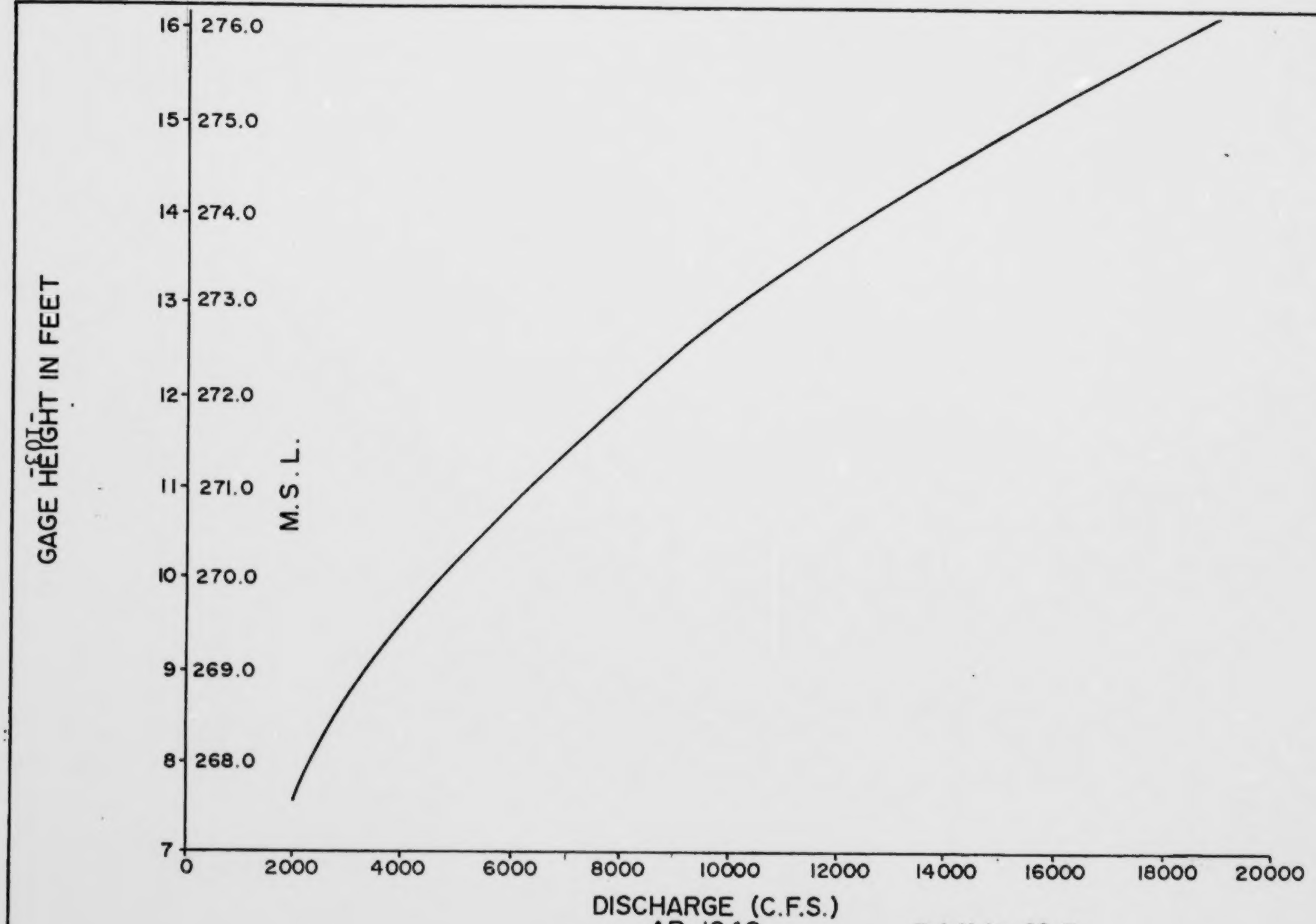


AR 1040
EXTREME HIGH WATER
ROCK CREEK AT W. 36TH

Exhibit 38-E

TEAFORD ENGINEERING ASSOC., INC.

MARCH 1982

SUMMERLIN ASSOC., INC.

and proceeding downstream. In Exhibit 36, tables 3, 4 and 5 illustrate the load which passed each station for the first, peak, and last increment of the hydrograph. Data values are graphed in Exhibit 37, and rating curves are presented in Exhibit 38. The BMP is located between Markham Road and Shackelford.

The data suggested that storage is occurring at the BMP. Further investigation supported that conclusion. Further investigation included an analysis of settling rates in the BMP.

Additional water sampling data and analysis are presented in the Data Report (Volume II of this report).

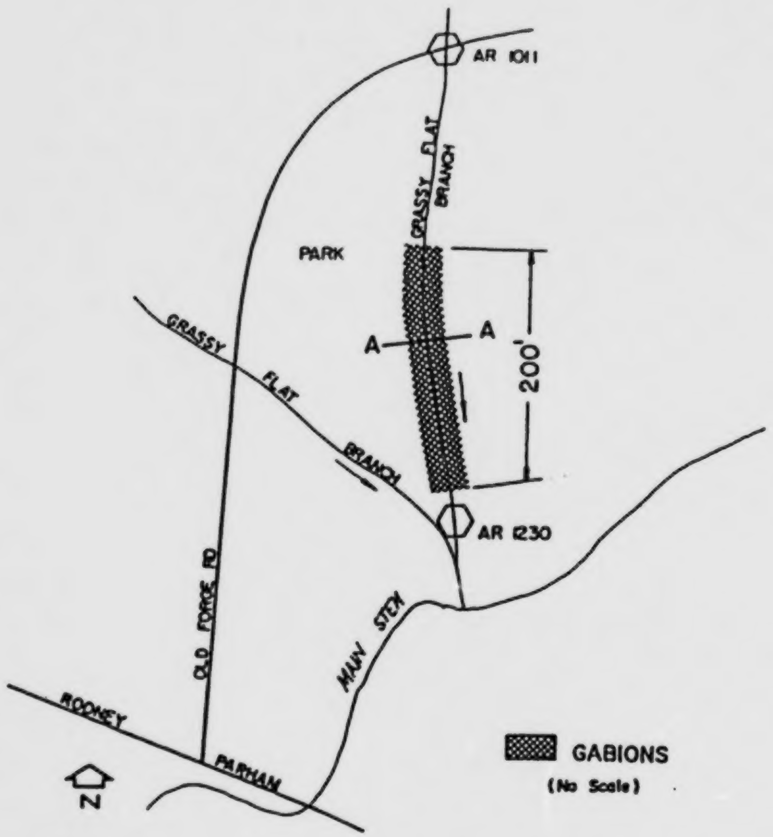
Grassy Flat Creek

Gabions installed on Grassy Flat Creek demonstrated this approach as cost effective for areas where insufficient right-of-way exists to implement other measures (Exhibit 39). Erosion of banks was halted and biological activity such as plant growth and insect and rodent habitat on the bank continues. There is some storage predicted in the banks. These benefits were realized at a cost significantly lower than had continuous reinforced concrete retaining wall been installed.

As expected, the results of our findings illustrated that there is a definite link between the water quality in the streams and the mode of transportation of the water into the creek and through it.

As in the case of Grassy Flat branch, eroding earth-walled channels conveying storm runoff contribute sediments to the stream loadings. Armoring the banks with gabions effectively eliminated the channel itself as a sediment source. Ratings curves for the study stream are presented in Exhibit 40.

GRASSY FLAT BRANCH


AR 1011
GRASSY FLAT BRANCH
PARK
A
A
200'
GRASSY FLAT BRANCH
AR 1230
OLD FORGE RD
MAIN STEM
ROONEY
PARHAM
N
GABIONS
(No Scale)

CREEK SECTION A-A

BEFORE GABIONS INSTALLED

AFTER GABION IMPROVEMENT

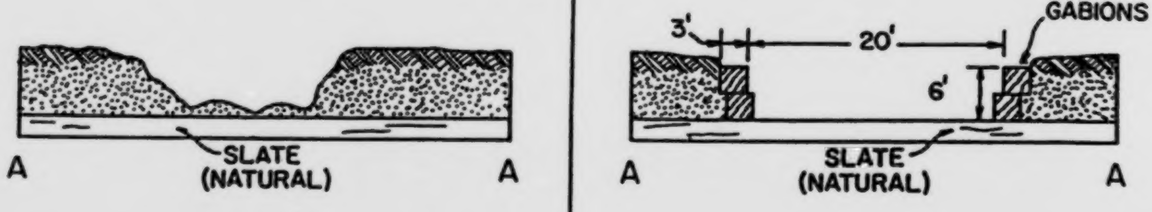
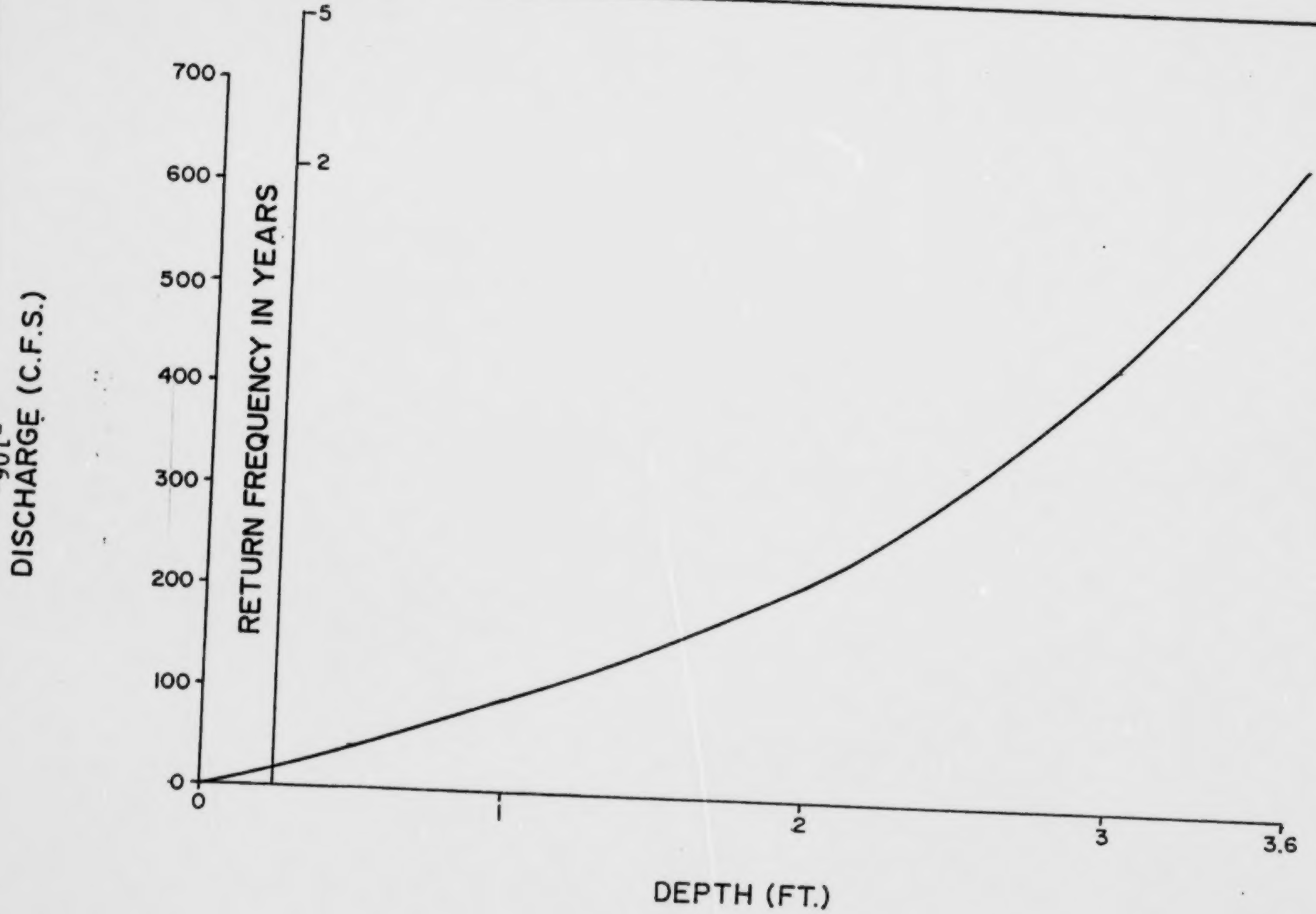

SLATE (NATURAL)
A
A
3'
20'
GABIONS
6'
SLATE (NATURAL)
A
A

Exhibit 39

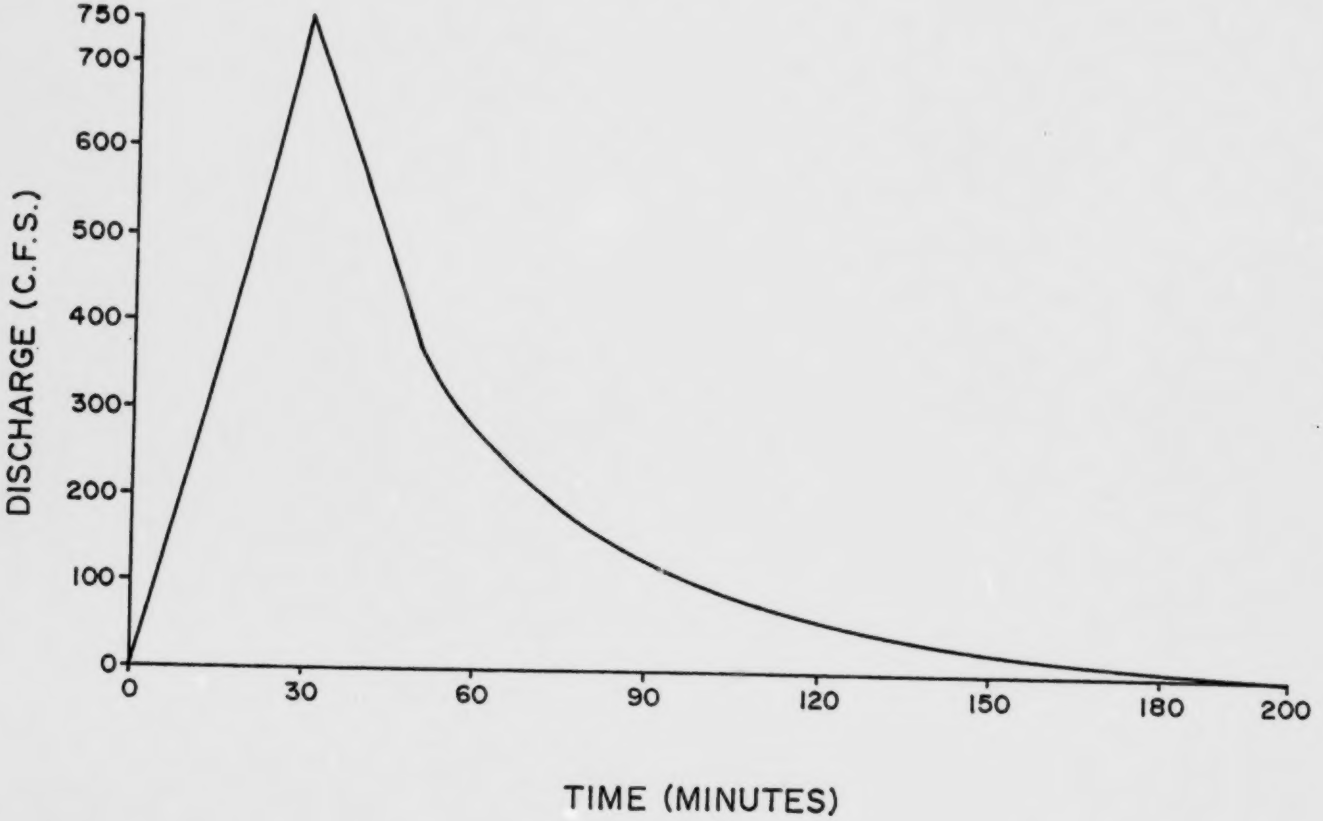


AR 1101
OLD FORGE AT COACHLITE

Exhibit 40-A

TEAFORD ENGINEERING ASSOC., INC.

MARCH 1982



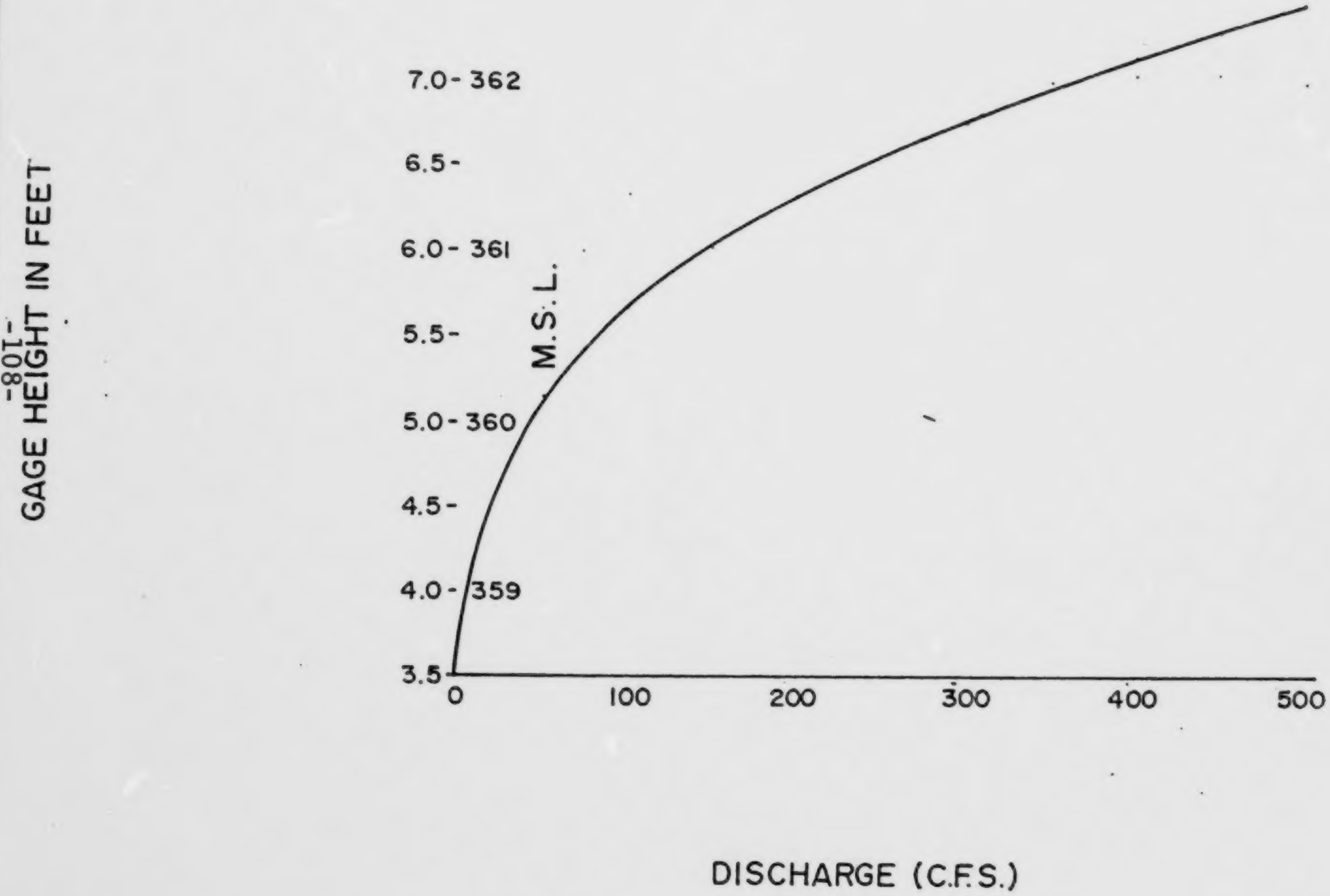
AR 1101
OLD FORGE AT COACHLITE

Exhibit 40-B

TEAFORD ENGINEERING ASSOC., INC.

MARCH 1982

SUMMERLIN ASSOC., INC.

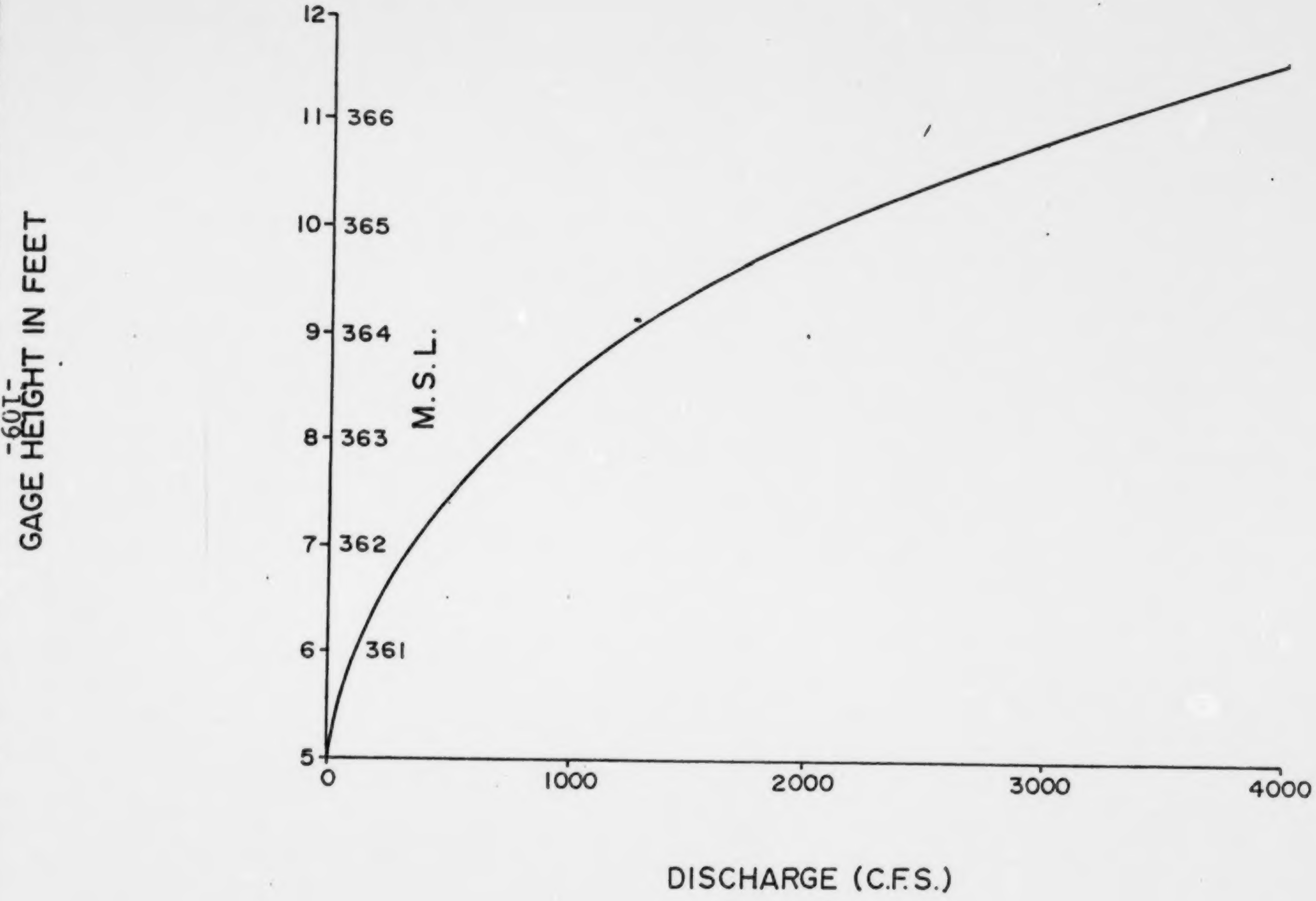


AR 1010
LOW WATER
GRASSY F.LAT RESERVOIR RD.

Exhibit 40-C

TEAFORD ENGINEERING ASSOC., INC.

MARCH 1982



AR·1010
HIGH WATER
GRASSY FLAT RESERVOIR RD.

Exhibit 40-D

TEAFORD ENGINEERING ASSOC., INC.

MARCH 1982

SUMMERLIN ASSOC., INC.

Second Year BMP Sampling Program

An attempt was made to determine the impact of the controls both as BMP's for immediate stormwater pollutant reductions and for their use in combination as a system of measures to improve water quality in the receiving streams. An evaluation of their effectiveness was projected to be a function of the storm intensity and, consequently was related to the 2, 5, 10, 25, 50 and 100 year return frequency storms. It was hoped that by tying these BMP's into the return frequences of the storms a reasonable degree of predictability could be obtained concerning the water quality impacts of stormwater pollution.

The proposed sampling program included the sites identified on Exhibits 28 and 41-43. The sampling increased the level of effort in the Rock Creek, Grassy Flat, and Coleman Creek basins. This included the sampling required to evaluate the water quality effects of the BMP's. Tables 1-3 illustrate the sampling program which was undertaken.

The emphasis of the sampling program was to illustrate and evaluate, to the extent possible, the effectiveness of selected Best Management Practices (BMP's) implemented in the Metroplan NURP study area. In addition to the BMP evaluation samples, a sampling program was conducted at Rock Creek, a major urban tributary of Fourche Creek. The sampling was the basis for developing a comprehensive program of BMP's which, when implemented, will be fully integrated into the natural park setting along the city's creek. The sampling provided data which illustrated the effects that the existing park system has upon the water quality of the area streams.

A Quality Assurance Program as specified by the Environmental Protection Agency (EPA) guidelines was included as a part of the second year BMP evaluation program. A description of the requirements of the Quality Assurance Program is included in the appendix.

The UALR and representatives of Metroplan jointly selected specific sampling sites for the work required during the second year.

Exhibit 41

Table 1 lists the BMP sampling stations. In Table 2, where "Field Measurements" is listed as a parameter, these included the temperature, ph, DO, flow, time, rainfall, specific conductance and antecedent conditions. Table 3 summarizes the sampling scheme.

Table 1
Sampling Sites for BMP Evaluation
Metroplan NURP Project

		COLEMAN CREEK	
1.	AR 1022	Left Branch	At War Memorial Park
2.	AR 1033	Right Branch	At War Memorial Park
3.	AR 1240	Downstream of BMP	At War Memorial Park
		GRASSY FLAT CREEK	
4.	AR 1011	Old Forge at Coachlite	
5.	AR 1230	Old Forge at Breckenridge Park	
		ROCK CREEK	
6.	AR 1020	West Markham	
7.	AR 1210	Shackleford Road	
8.	AR 1310	I-630	
9.	AR 1220	Boyle Park	
10.	AR 1040	36th Street	

Exhibit 42

Table 2

Sampling Scheme at BMP Evaluation Sites

Site	Calibration	Number of Samples Composite
AR 1022	1	3 to 5
AR 1033	1	3 to 5
AR 1240	1	3 to 5
AR 1011	1	2
AR 1230	1	2
AR 1020	0	3 to 5
AR 1210	1	3 to 5
AR 1310	1	3 to 5
AR 1220	1	3 to 5
AR 1040	0	3 to 5

- Parameters for analysis included field measurement (time, discharge, temperature, D.O. for specific conductance antecedent condition), pH, TSS, BOD, TN, TP, Fecal Coli, 1-3 metals.

- Calibration sampling was discrete with analysis on each sample.

- Composite sampling was discrete with analysis performed on a flow weighted composite sample.

The contractor collected, preserved, transported, and analyzed all samples according to the techniques and procedures of "Standard Methods for the Examination of Water and Wastewater," 14th edition, and/or "Methods for Chemical Analysis of Water and Wastes" 1974, by the Environmental Protection Agency.

Where instantaneous discharges were required as a part of the sample information, the discharge estimates were made using measured velocities and cross sectional flow areas, stage-discharge ratings, or other methods.

The contractor used field personnel properly instructed and trained to assure correct sampling, preservation, and transportation techniques.

In compliance with Environmental Protection Agency requirements the UALR analyzed duplicate and spike samples for 10 per cent of all the samples collected and analyzed. The analyses for duplicate samples and spike samples was considered as a part of the total laboratory analyses required.

The contractor sampled those sites outlined in Tables 1 and 2. The sampling was divided into four parts (1) calibration, (2) composite, (3) Rock Creek Stream Survey and (4) other miscellaneous sampling. The sampling for (1) calibration was during a rainfall event and was collected during an event to produce a definable hydrograph. The sampling was made up of at least seven (7) discrete samples. At least three samples were taken during the rising leg of the hydrograph and four (4) after the peak of the hydrograph. The sampling for 2 composite was sampled the same as the calibration samples but was composited on a flow proportioned basis.

Sampling for 3 Rock Creek Stream Survey, included data necessary to calculate time of travel, reaeration coefficient and to follow a slug of water during a storm event through its stream length. Miscellaneous data collection was set aside to collect up to 35 samples or five events for the purpose of being able to respond to varying conditions or unusual situations which might have arisen during the contract period.

It was proposed that a maximum of 48 sampling trips would be required to collect and analyze a maximum of 322 samples/year. The duplicate and spike samples analyzed for quality control purposes were considered as regular analyses and therefore enumerated as part of the samples upon which this contract is based.

Exhibit 43

TABLE 3

	BOD's	TSS	TP	TN	FECAL COLI	FE	pH	FIELD MEASUREMENTS	RAIN FALL
AR 1022	28	28	28	28	28	28	28	28	28
AR 1033	28	28	28	28	28	28	28	28	28
AR 1240	28	28	28	28	28	28	28	28	28
AR 1011	28	28	28	28	28	28	28	28	28
AR 1230	28	28	28	28	28	28	28	28	28
AR 1020	21	21	21	21	21	21	21	21	21
AR 1210	28	28	28	28	28	28	28	28	28
AR 1310	28	28	28	28	28	28	28	28	28
AR 1220	28	28	28	28	28	28	28	28	28
AR 1040	21	21	21	21	21	21	21	21	21
	322	322	322	322	322	322	322	322	322

NOTE: Number illustrates minimum samples collected, 25 per cent or 7 samples were analyzed as discrete. The balance or 21 samples were composited and analyzed as 3 samples.

Findings and Conclusions

The mean storm in the study area is .43 in. and lasts 4.8 hrs. at a rate of 0.09 inch/hour. The mean storm occurs every 76 hours. Ninety-seven per cent of the events have a return frequency at one year and less. Of the total storms 70% are less than the mean storm of .43 in. There are 27 storms per year greater than the mean storm and less than the 1 year return frequency storm leaving 8 storms/year over the return frequency of one year.

Data from the Fourche Creek study showed water quality improvement on storms with precipitation volume equal to or less than the 1 year return frequency storm. Some data exist for longer return frequency storms, and the results are meaningful on about 92 to 97% of the storms which can be expected to occur. The one year storm intensity is approximately .1" per hour. The average storm above the 1 year frequency has an average intensity of 1.61" per storm.

Results of sampling at the Rock Creek and Coleman Creek sites are included in the following table (Exhibit 44). The results show that both systems of BMP's are successful in removing pollutants from the runoff.

The BMP costs have been reduced to a $/pound per year and to a cost per square foot of drainage basin treated (Exhibit 45). The BMP at Rock Creek cost about 50% less per square foot than the Coleman Creek system, but both were effective in cost and size when comparing with the whole basin. The BMP's were between 0.2% and 0.4% of each drainage basin's total area. The Rock Creek System had a cost of $17.20 per linear foot. Even if land cost $10,000/ac., the cost would be $64 per linear foot, much less than $150/250-linear foot estimated for a complete concrete structure.

Exhibit 44-A

	BMP SITE	ROCK CREEK
	STORM EVENT % Removal of Pollutants	
	January 22, 1982	November 19, 1982
BOD	27%	20%
SS	30%	58%
TKN	-18%	22%
TP	-16%	49%
CU	*N/A	26%
ZN	*N/A	23%
FE	*N/A	-.22

ROCK CREEK

STORM EVENT

November 19, 1982

BMP SITE

	Up Stream	Down Stream	% Removal AS (EMC) +
BOD	6.12	6.4	-5%
SS	202	153	24%
TKN	1.71	1.75	-3%
TP	.212	..140	34%
CU	.025	.021	1.6%
ZN	.02	.02	-
FE	4.02	4.05	-.7%

---

*NA = Not available for this event.

+EMC = Event mean concentration.

(Identical with Exhibit 33)
Exhibit 44-B

Table 1-A

Summary of Storm Event
Coleman Creek

January 2, 1982

	AR 1033 RB	AR 1022 LB	AR 1240 DS	Reduction (lbs)	Reduction %
BOD	1,814	454	1,641	627	28%
SS	17,291	11,358	27,586	1,063	4%
TN	237	81	252	66	21%
TP	100	41	81	60	43%
VOL (MG)	23.58	5.04	16.5		42%

Table 1-B

Coleman Creek

November 11, 1981

BOD	1,250	332	885	697	44%
SS	42,025	14,407	33,509	22,923	41%
TN	353	108	247	214	46%
TP	98	48	102	44	30%
VOL	16.53	5.59	14.26		36%

AR 1033 - Right branch of Coleman Creek upstream of BMP

AR 1022 - Left branch of Coleman Creek upstream of BMP

AR 1240 - Downstream of BMP's Coleman Creek

Exhibit 44-B(cont'd)

Table 1-C

Coleman Creek

October 23, 1981

	AR 1033 RB	AR 1022 LB	AR 1240 DS	Reduction (lbs)	Reduction %
BOD	1,913	50	1,388	575	29%
SS	10,806	576	13,273	-1,792	-16%
TN	428	11	253	186	42%
TP	121	3	81	43	35%
VOL (MG)	40.18	1.16	29		30%

Exhibit 45

NURP ANALYSIS FOR ROCK CREEK AND COLEMAN CREEK

COSTS

		Rock Creek	Coleman Creek
REMOVAL OF --- IN LB,	BOD	316	633
	SS	20,812	7,000
	TKN	96.5	150
	TP	53.2	50
THERE ARE 27 STORMS PER YEAR WHICH AVERAGE .43 IN/STORM			
	BOD	8,532	17,091
	SS	561,924	189,000
	TKN	2,605.5	4,050
	TP	1,436.4	1,350
TOTAL COST FOR LABOR AND MATERIALS		$67,000	$40,000
$ COST PER POUND OF REMOVAL	BOD	$ 7.8528	2.3404
	SS	.11923	.21164
	TKN	25.715	9.8765
	TP	46.644	29.630
20 YR. NO INTEREST COST/YR PER-LB			
	BOD	$ .39264	.11702
	SS	.00596	.01058
	TKN	1.2857	.49383
	TP	2.3322	1.4815
DRAINAGE AREA-IN AC.		4,700	980
--- COST PER ACRE (TOTAL LABOR & MATERIALS)	BOD	$ .00167	.00239
	SS	2.5-5	2.2-4
	TKN	.00547	.01008
	TP	.00992	.03023

V. URBAN RUNOFF MANAGEMENT PLAN

One of the major products of the Fourche Creek Urban Runoff Project is the Urban Runoff Management Plan. The purpose of the management plan is to coordinate local efforts to manage nonpoint source problems as effectively as possible. These are generally dual in nature: flooding and pollution. In actual practice the two are generally inseparable, though flooding tends to remain the more serious concern of officials and the public. It is apparent from the work completed in the Fourche Creek Project that solving either is more effectively accomplished by addressing both concurrently. For this reason the Urban Runoff Management Plan has both water quantity and water quality objectives.

Plan Implementation Area

The Urban Runoff Management Plan for the City of Little Rock is intended to cover not only the existing city limits but also the extended planning jurisdiction which state law makes available to local officials. This is generally an area five miles beyond the city limits in which the city exercises planning and subdivision regulation powers and zoning authority within one mile of a navigable stream. It is recognized that planning for runoff management must begin very early while development, both private and public, is at a minimum. This has long been recognized as true for zoning and land use management as demonstrated by the enactment of the legislation giving cities extended planning and zoning powers. However, it is only lately that drainage, water quality, and other environmentally sensitive issues are receiving the same attention. In addition to the recommendations made in this report for the City of Little Rock, it is recognized that similar problems exist in other urban areas and urbanizing fringes lying around cities-proper. It is hoped that the recommendations presented in this report will be adopted in other cities and that the general management plan described here will become a model which others will follow.

The Management Plan

The Fourche Creek Urban Runoff Project demonstrated the cost effectiveness of a number of Best Management Practices (BMP's) in test situations. These are both technically and financially effective solutions to the main types of problems evident in Arkansas' urban areas. Primarily these BMP's are effective in reducing suspended solids and to a lesser extent, nitrogen, phosphorous and BOD. However, suspended solids remain, next to flooding, the most significant runoff management concern since suspended solids result in major loads from manageable sources such as construction sites.

The management plan consists of two major elements. First, several general recommendations are intended to be implemented system-wide and represent policy, institutional or legal considerations. Second, several specific BMP's are recommended which as structural controls are effective in managing runoff at specific sites.

To effectively control the impacts of urban runoff the city must enact measures system-wide to reduce water volumes, velocities, and improve runoff quality. These goals can be accomplished in several ways. Briefly these are:

(1) Integrate all city-wide planning into a comprehensive system of planning and review. Land use, drainage, park, and erosion management must be integrated to achieve maximum runoff management efficiency. This will lead to multi-purpose planning, and can best be accomplished by improving coordination and communication among the three city staffs responsible for different planning activities -- Public Works (drainage), Parks and Recreation (parks), and the Office of Comprehensive Planning (land use, zoning, subdivision regulations). The easiest way to realize the desirable enhanced communication would be for the Office of Comprehensive Planning to routinely meet with the other two offices, review their projects, and continually monitor inter-office communication involving significant, long-range planning projects. In addition, it is logical for the OCP to incorporate the objectives of the public works and parks planning projects into the city's master plan.

(2) The city Comprehensive Development Plan should promote drainage and water quality management goals in addition to the traditional land use, facilities, and zoning considerations. This would include amending subdivision regulations to include on-site retention during and after construction as necessary and other pollution abatement controls.

(3) The city Master Drainage Plan (under revision) should focus on recreational and water quality management goals in

addition to flood reduction objectives, and result in improved on-site retention of water and associated pollutants.

(4) The city should adopt an erosion management ordinance that includes management at construction sites. This proposal is under study and a draft plan is being reviewed.

(5) The city should adopt an accelerated capital improvement policy for drainage, water quality and recreation projects rather than relying to such an extent on stop-gap maintenance programs.

(6) The city should regulate public construction projects which generate erosion problems as effectively as private.projects for which an erosion control ordinance is being developed.

(7) The city Master Parks Plan, under revision, should be used as a vehicle for water quality and water quantity management. It should be closely coordinated with the Master Drainage Plan and acquisition of new park lands and stream buffers should be accelerated with this objective in view.

(8) The Landscape Ordinance should be strengthened to contribute to on-site water quality and water quantity management by improving its enforcement.

These general improvements should be accompanied by specific, on-site BMP installation on both public and private project sites. Specific BMP's which have been shown to be technically and financially effective through the Fourche Creek Urban Runoff Project include:

(1) Reduced slopes

(2) Rip rap

(3) Grassing and sodding

(4) Retention basins

(5) Grassed drainage or overflow areas

(6) Gabions

These BMPs can be effectively combined in public parks, landscaping and other projects and in subdivisions where common areas or private parks exist to reduce runoff velocities and improve water quality reaching receiving streams. This can be achieved by combining the provisions and powers of the city's various plans and authorities.

Metroplan developed and tested these BMPs at sites selected by the city staffs. It is recommended that the engineering and technical staffs of the Parks and Recreation and Public Works Departments adopt them at specific sites, but of the city's choosing.

Projects at specific sites should be considered here however when they are of a major obvious concern. In the management planning area there are two. The Little Rock Zoo was shown in the Fourche Creek Urban Runoff Project to be a significant source of coliform pollution to Coleman Creek. Metroplan worked with the city Parks Department and the Wastewater Utility to develop a plan to eliminate this problem, This plan is under review by the State of Arkansas and should be supported with adequate funding. The second project is a flood reduction project to be conducted by the U.S. Corps of Engineers on the main stem of Fourche Creek and on the tributaries Rock and Grassy Flat Creeks. For this project to be finally and lastingly effective, the measures outlined above for limiting runoff from the developing areas of the city must be enacted.

Acceptance and implementation of the recommendations presented above would lead directly to integrated environmental planning within city government and improved efficiency. Projects now proposed by Public Works and Parks and Recreation would more likely be constructed or involved acreages purchased because they would represent multi-use projects supported by larger constituencies. Innovation in financial packaging would also be improved since several sources of funds, local, state and federal, could be combined in multi-purpose projects. Thus, for example, as the Parks and Recreation Department implements the Master Parks Plan, minimum twenty-five foot buffers along most of the city's streams will be purchased. It is the intention of the Parks Department to use these buffers for paths, trails, and connecting links between parks, and as stream protection measures (see map of project areas). This latter objective coincides with plans of the Public Works Department which is responsible for drainage projects. If the two departments coordinate land acquisition and erosion management, buffer maintenance, and other water quality controls with recreation goals, public support will increase and project costs should be lowered.

From the first, it has been the policy and the intent of Metroplan to use and build on existing institutions in carrying out the Fourche Creek Urban Runoff Project. This has been important in the selection of test areas for BMPs and in the choice of BMPs themselves. It is especially important that recommendations, such as the proposed Runoff Management Plan, be developed with local institutional arrangements, policies and goals in mind. The result will be serious consideration of the recommendations. Metroplan's recommendations suggest ways of improving existing arrangements and provide verification of the effectiveness of structural and non-structural BMPs. This combination should support the best likelihood that they will be adopted by local professional staffs and public officials.

VI. CONCLUSION AND RECOMMENDATIONS

Public Participation

In accord with EPA regulations for the 208 projects, Metroplan provided for and directed public involvement activities to insure full access of the 208 area citizens to the Fourche Creek Urban Runoff Program. These public participation activities included establishment of an advisory committee, the composition of which conformed to EPA regulations, selection of a contact person to accept and respond to citizen comments, press coverage, public meetings and hearings advertised in compliance with EPA regulations, utilization of information depositories, and the preparation of audio-visual aids. The full intention of Metroplan and the cooperating agencies in developing and conducting the public involvement program was to gain and effectively utilize the participation of citizens in the urban runoff program. Publics targeted for involvement in the project included homeowners in neighborhoods affected by urban runoff problems, builders, developers, financiers, engineers, elected and appointed officials, conservationists, city services departments, pest control and lawn maintenance companies, major contractors, industries, the 208 management agencies responsible for urban and construction runoff and private citizens. Metroplan prepared responsiveness summaries suggested by EPA at critical decision points in the project. When possible, public involvement activities of Metroplan were coordinated with public involvement activities of other EPA-funded programs in the Little Rock area.

A summary of specific public participation activities is presented in the Appendix B to this report.

Despite the extraordinary lengths to which the Metroplan staff went to secure active, continuing participation of selected target publics in the Fourche Creek Project, such participation was limited and intermittent. When specific issues were involved, pollution control linked with flood reduction or sewage contaminated streams, participation improved considerably. The Citizen Advisory Committee supported a number of staff recommendations which led to concrete community action. Streams in the city parks were posted to warn the public not to use them for contact recreation after the staff presented the first year stream sampling. The advisory committee requested that the city post the streams because of high coliform levels after the State of Arkansas refused to address the issue. The City Parks and Recreation Department accepted responsibility and posted the streams.

The Citizen Advisory Committee endorsed and wrote in support of a proposed Erosion Control and Clearcut-Management Ordinance which the city engineering staff has prepared and is attempting to have enacted. The citizen's group has also supported other projects to reduce flooding when these projects were reviewed in the context of the Fourche Creek Project.

Yet, without a specific, definable issue the committee and local public officials remain more concerned with matters perceived to be of more importance, such as fire and police protection and the public schools. The willingness of the public to support local projects, even water quality improvement projects, has been demonstrated repeatedly when the projects are "packaged" attractively as multi-purpose projects, eg., flood control and park improvements or when a major concern is addressed. An example of the latter would be approval of a rate increase to permit expansion of the city's Adams Field Sewage Treatment Plant.

In the public's view, water quality in the Little Rock area is excellent. Indeed, the area enjoys the reputation for exceptionally good water quality due primarily to the high quality of its raw water supply drawn from rural lakes. The fact that the urban streams are of much poorer quality because of runoff has not been perceived by the public as yet. Until it is, local government will in all probability continue to respond to water quality issues as secondary concerns.

One segment of the publics encouraged to participate in the Fourche Creek Project is especially well mobilized and vocal. The developers, builders and commercial contractors, are unified in opposition to any changes which they fear will increase local control over their activities or increase costs. Their opposition to the city staff's proposed erosion control ordinance has been extremely effective in slowing its adoption. This is curious in light of the fact that the ordinance was developed with suggestions provided by the National Association of Home Builders which has endorsed erosion management techniques as a means of reducing project construction and maintenance costs.

Occasionally the city staff encounters opposition from groups living outside the corporate limits but within the extended planning jurisdiction of the city. This occurs when the city proposes changes to land use or subdivision plans and regulations.

The best means of overcoming these types of resistance which many times arise from misunderstandings has been suggested in recommendations above in the management plan. It is necessary to generate interest among many constituencies in support of proposed projects by developing and using multi-purpose objectives. The number of publics affected will be increased and support, assuming the project is a viable, needed, cost effective one, will grow. Coordination and communication among city departments and local officials must be improved to realize this advantage.

Institutional Considerations

Coordination and communication were a theme pursued by EPA throughout the Nationwide Urban Runoff Program. This resulted in the first comprehensive assessment of urban runoff impacts nationwide and in the testing and evaluation of a number of specific BMPs. The interchange of data and information was provided for and encouraged by EPA-Washington. One of the most valuable exercises of the nationwide program was this interchange aspect and it is also the one most needed at the local level.

As the recommendations presented in NURP plans are reviewed and considered by local authorities, Metroplan hopes that two will be outstanding as of major significance. They are available for rapid, non-disruptive incorporation into local government institutional arrangements. These are adoption of multi-purpose project goals, the "piggyback" principle of coupling water quality objectives with those of other public projects such as flood control. Secondly, improved communications among local planners, especially within city departments is essential.

These changes could be accomplished fairly easily in Little Rock since the city government staff is of sufficient size and with ample specializations to address any planning issue. Multi-purpose project planning will be realized as communication among departments improves. It is hoped that the Fourche Creek Urban Runoff Project will testify to the desirability and demonstrate the effectiveness of this approach. In this project Metroplan coordinated and contributed to the work of the Public Works and the Parks and Recreation Departments as they implemented different BMPs at several locations. In routine operations, [illegible]plan's role could be easily and profitably assumed by the city Office of Comprehensive Planning as a coordinating entity for the Little Rock professional staffs.

Specific Recommendations and Conclusions

With these general considerations in mind and in light of the recommendations presented elsewhere in this report, a number of conclusions emerge from the Fourche Creek Urban Runoff Project and suggest a number of measures which can be readily adopted in the metropolitan area to improve stream water quality.

(1) Conclusion: Water quality degrades as streams flow through the Little Rock urban area. The negative impact of urban runoff is obvious.

Recommendation: The Urban Runoff Management Plan described above in Section VI, should be implemented by the City of Little Rock.

(2) Conclusion: Toxics are not a major concern in the Fourche Creek system.

Recommendation: Specific sources of toxics should be scrutinized if signs of toxic pollutants appear. In the meanwhile, the waters of the Fourche Creek system should be scanned periodically for the evidence of significant concentrations of toxics. No other measures are needed at this time.

(3) Conclusion: Suspended solids, coliform bacteria, nitrogen and phosphorous are expensive to remove from urban runoff. However, removal costs become justifiable when amortized as part of drainage or parks improvements.

Recommendation: Priority should be placed on the most significant pollutants and those which can be removed most cost effectively.

(4) Conclusion: It is more cost effective to remove suspended solids than other pollutants in urban runoff. Suspended solids and coliform bacteria are the major pollutants evident in the Fourche Creek system. Bacteria are difficult to remove.

Recommendation: A. The primary clean up effort should focus on suspended solids removal.

B. The city should adopt an erosion control ordinance.

C. Public projects should be subjected to erosion controls.

D. Bacteria sources should be addressed whenever specific site problems make removal cost effective, or life or health threatening conditions are of overriding concern, otherwise the receiving waters should be posted against contact recreation.

(5) Conclusion: The BMP's studied (grassing; rip rap; gabions; reduced slopes; channel widening) are affordable and effective, especially when compared with traditional structural controls such as concrete ditches, and if implemented in conjunction with high priority projects such as drainage and parks improvements.

Recommendation: Implement these BMP's wherever sufficient area exists to allow effective application.

(6) Conclusion: BMP's which closely mimic natural structures such as forests, ponds, and grassed areas work most effectively to manage urban runoff. They promote continuing biological activity in the stream, and are generally less expensive than traditional concrete solutions.

Recommendation: Avoid use of concrete channels and other primarily artificial solutions to runoff management. Treat water, do not simply move it. Maximize use of the parks and other public areas as sites for treating urban runoff.

(7) Conclusion: It is easier to treat water on-site at the source.

Recommendation: Install controls in batteries as close to the source as possible.

(8) Conclusion: Local approaches to solving urban runoff problems are uncoordinated.

Recommendation: City departments practicing planning and environmental management should coordinate their activities. It is especially important to integrate drainage, parks and recreation, solid waste, land use and other types of planning and control activities to insure maximum efficiency.

(9) Conclusion: Water quality issues are of little interest to the public unless a specific blatant problem is involved.

Recommendation: Merge water quality objectives and issues with others identified in the public mind as more significant such as toxic waste management, flood reduction, park development or land use regulation. Employ a "piggyback" principle to broaden the constituencies by proposing multi-purpose projects.

(10) Conclusion: Solutions to water quality management programs are uncoordinated.

Recommendation: The coordination of federal, state, and local water quality management programs should be centralized at the local level. This cannot be done effectively at the state or federal level because the problems are primarily local in origin and local priorities determine whether resources are made available for solutions. Where urban governments are sufficiently large and sophisticated the opportunity for effectively solving water quality problems exists. This was the basic message of the Areawide Water Quality Management Program (208 areawides) out of which the NURP projects developed.

VIII. APPENDICES

(1) Water Quality: Metroplan and its contractors followed the requirements of the NURP Quality Assurance Program Guidelines, a copy of which is found below as Appendix A.

(2) Priority pollutants (129 toxics) included as part of the first year sampling program are listed below as Appendix B.

(3) Public Participation: Metroplan conducted the public participation program of the Fourche Creek Urban Runoff Project according to the regulations required by the EPA of all water quality management program grants. A summary of the activities is included below as Appendix C.

APPENDIX A

QUALITY ASSURANCE

APPENDIX A

QUALITY ASSURANCE
for the
NATIONWIDE URBAN RUNOFF PROGRAM

I. INTRODUCTION

Data collection and analysis will form one of the most important information sources for the Nationwide Urban Runoff Program (NURP). Therefore, it is essential that the monitoring programs that produce these data be soundly based and that they incorporate Quality Assurance (QA) as an integral part of their structure. This is as necessary for problem assessment monitoring as it is for Best Management Practice (BMP) effectiveness monitoring. A rather thorough discussion of 208 monitoring requirements, methods, and costs is contained in Appendix D of the Areawide Assessment Procedures Manual (AAPM), and the user is encouraged to become familiar with that material before embarking on any data collection activity under NURP. The following material is intended to augment the AAPM in the area of QA, and it should be incorporated in such NURP efforts.

The need for comparability, transferability, and nationwide assessment mandate the incorporation of QA by all NURP designated prototype projects. However, local exingencies dictate that a procrustean bed approach to standardization of QA programs is not at all desirable. Therefore, what follows should be viewed as illustrative rather than prescriptive and should be used as a guide in developing sound, sensible QA programs that will be workable at the local level for inclusion in NURP prototype projects. As these QA programs are developed, they should be forwarded to USEPA Regional and Headquarters Offices for review and comment prior to implementation. In this way, the necessary degree of standardization can be obtained without placing undue restrictions on any particular prototype project.

II. GENERAL

No monitoring program can be any better than its quality control program allows it to be. In order to be effectively transformed into information, we need more than simple values as monitoring data products. We need to know something about the data quality, i.e., about the "goodness" or truthfulness of the data. Two terms that relate to the data-gathering process are conventionally used to describe data quality: accuracy and precision. Accuracy refers to the agreement between the measurement and the true value of the measurand, with the discrepancy normally referred to as error; precision refers to the reproducibility (repeatability) of a measurement when repeated on a homogenous time-stationary measurand, regardless of the displacement of the observed values from the true value, and thus indicates the number of significant digits in the result. We are, therefore, interested in establishing the best estimate of a measured quantity and the degree of precision of this estimate from a series of repeated measurements. Calibration, whether it be of a piece of flow measurement equipment, a chemical method for wastewater analysis, a stormwater management model, or whatever, is simply the process of determining estimates of accuracy and precision.

Discrepancies between the results of repeated observations, or errors, are inherent in any measurement process, since it is recognized that the true value of an object of measurement can never be exactly established. These errors are customarily classified into two main groups: systematic and random (or accidental) errors. Systematic errors usually enter into records with the same sign and frequently with either the same magnitude (e.g., a zero offset) or with an establishable relationship between the magntitude of the measurement and the error. The methods of symmetry and substitution are frequently used to detect and quantify systematic errors.

In the method of symmetry, the test is repeated in a symmetrical or reversed manner with respect to the particular condition that is suspect. In the method of substitution, the object of measurement is replaced by one of known magnitude (a calibration standard), an instrument with a known calibration curve is substituted for the measuring instrument in question, and so on. Thus, systematic errors bear heavily on the accuracy of the measurement.

Random errors, on the other hand, are due to irregular causes, too many in number and too complex in nature to allow their origin to be determined. One of their chief characteristics is that they are normally as likely to be positive as negative and, therefore, are not likely to have a great effect on the mean of a set of measurements. The chief aim of a data quality assurance effort is to account for systematic errors and thereby reduce errors to the random class, which can be treated by simple probability theory in order to determine the most probable value of the object of observation and a measure of the confidence placed in this determination.

The statistical measures of location or central tendency (e.g., the various averages, mean, median, mode, etc.) are related to accuracy. The statistical measures of dispersion or variability (e.g., variance and standard deviation, coefficient of variation, and other measures derived from central moments of the probability density function) are related to precision.

Even lacking enough data for statistical treatment, there are some annotations that the data gatherer can make to increase the usefulness of the data. For example, inspection of equipment and records may indicate periods of instrument malfunction or failure (e.g., power interruptions). These facts are important and should form a part of the total record. There may be circumstances discovered during site visits that would have an effect on preceding data that cannot be readily determined, e.g., a partially blocked sampler intake, a rag caught in the notch of a weir, etc. These facts should also be noted and, where at all feasible, some qualitative notation as to expected data quality (e.g., poor, very good, etc.) should be made.

III. QUALITY ASSURANCE CONTROL COORDINATOR

Assignment of responsibility is essential in establishing a viable quality assurance (QA) program. Therefore, a QA control coordinator should be designated and given responsibility for the entire monitoring QA program. Although the level of effort expended by this person will be a direct function of the size of the overall monitoring program, where at all possible it should be considered a full-time position. In its minimal requirements for a water quality assurance program, the USEPA provides the following guidance for this position.

A. Qualifications

1. The coordinator should have, as a minimum, a bachelor's degree in chemistry, biology, or microbiology, with at least 5 years of experience in his respective discipline. In addition, the coordinator must have actively worked in a water quality laboratory for at least 2 years. Experience in statistical quality control techniques and/or academic courses in mathematics and statistics is also highly desirable.

2. The coordinator maintains close liaison with the appropriate USEPA Regional Analytical Quality Control Coordinator and is responsible for the overall quality assurance program in his laboratory. The coordinator should report to the appropriate level: In no case should his function be subordinate to an individual responsible for direct conduct of sampling or analyses.

B. General Duties and Responsibilities

The coordinator is responsible for developing and implementing an inter and intralaboratory quality control program. Specific duties include, but are not necessarily limited to:

1. Participating in the overall quality control plan. This includes all elements of the sampling and analytical programs. The coordinator carries out this activity within USEPA quality control and methodology guidelines. Other recommended and accepted procedures can be used to supplement these guidelines.

2. Administering the interlaboratory quality control program as a continuing in-house activity to ensure the integrity and validity of analytical data.

3. Measuring the precision and/or accuracy of analytical results. Provides online quality control of samples, i.e., reference samples, duplicates, control charts, and spiked and audit samples.

4. Providing a permanent record of instrument and analyst performance as a basis for evaluating data.

5. Identifying training needs and technical methodology gaps.

6. Upgrading the overall quality of laboratory performance by recommending procedural and personnel changes, as required, to ensure the validity and integrity of the data.

7. Coordinating the inter and intralaboratory quality control program with the Environmental Monitoring and Support

Laboratory, Cincinnati (ESML-CIN), and other governmental and commercial laboratories. This involves participating in round-robin methodology studies and providing quality control check samples to requesting laboratories.

8. Evaluating and discussing the results of activities outlined in items 1 through 7 above with the appropriate individuals involved. When an analysis is out of control or a discrepancy is noted, the coordinator should be notified and appropriate corrective action should be taken.

The coordinator should develop a training program to ensure a minimal level of proficiency. He must recognize variations in ability and provide training to ensure that professional skills are appropriate to the task. Training programs should be administered in order to develop that level of competence which is necessary to carry out assigned functions. Moreover, these programs should be carried out in full cooperation with USEPA regional analytical quality control coordinators.

The coordinator should establish basic requirements (equipment, proper facilities, etc.) for operating a water quality laboratory. These requirements should not be included as part of the quality assurance budget. Laboratory facilities should provide an environment free from atmospheric contaminant levels, which can affect the desired analyses. The laboratory should be clean, air-conditioned and/or heated, and have a well-lighted work area. Safety features and other facilities consistent with operational requirements should be provided.

The coordinator will implement his planned quality assurance program with an initial onsite laboratory evaluation. Subsequent performance of analysis on audit samples and participation in split sample programs with the USEPA regional office should also be required.

IV. LABORATORY QUALITY ASSURANCE PROGRAM

The Environmental Monitoring and Support Laboratory (EMSL) has prepared a handbook for analytical quality control that provides sufficient information to allow inauguration or reinforcement of a program that will emphasize early recognition, prevention, and correction of factors leading to breakdowns in the validity of data products from water and wastewater laboratories.

A very important step that must be established before proceeding to the tests and studies discussed in the following paragraphs is the establishment of the precision and accuracy of methods used in the particular analytical laboratory involved. However, as one parameter is tested and its testing methods are checked for precision and accuracy, the test procedures that follow can be started for that parameter. After a 6- to 12-month period, all methods used in the laboratory should have been tested for precision and accuracy, and the following tests and studies begun.

According to the handbook cited above, actual samples, not standards, should be used to determine the precision and accuracy of the methods. The resulting data should be compared with published interlaboratory precision/accuracy data to determine that the analyses are in control. Once these data are documented, the procedural steps that follow should be practiced on a routine basis. Check the handbook for specific details.

Quality control check samples (reference samples) are provided as a technical service free of charge to the requestor, and can be obtained through the appropriate USEPA regional analytical quality control coordinator. Do not use them on a daily basis; rather, use them as an independent check on the entire system approximately every 3 to 6 months. The samples were prepared as sterile concentrate and are in sealed vials. Constituents available include mineral series, mercury, LAS, chlorophyll, and others to be announced.

The following studies are for laboratory performance and methods validation. They should be included in the overall quality assurance effort, and the results documented to ensure that data are valid.

1. Methods Validation Studies. The laboratory should participate in round-robin studies conducted according to official programs to determine the interlaboratory precision and accuracy of mthods.

2. Audit Sampling Programs. The laboratory should participate in the use of split, blind, performance check samples and other audit-type samples that are prepared either on an intra or interlaboratory basis. The resulting comparative data should compare favorably with the established precision and accuracy data of the respective measurements.

In terms of day-to-day activities, the normal working routine should require:

1. That duplicate samples be run approximately 10 to 20 percent of the time to verify the reproducibility of the respective methods. Data should compare favorably with initially established precision data.

2. That known amounts of standard material be added to samples on a 1-to-1 concentration basis to verify the ability of the method to measure the particular constituent under consideration. Again, approximately 10 to 20 percent of the time should be spent on this activity. The resulting data should compare favorably with the initially established accuracy data.

3. That some systematic, documented method for recording quality assurance data be in routine use. The method should be prepared so that it is available for future reference and can be readily understood and interpreted by all concerned.

V QUALITY ASSURANCE IN THE FIELD

A. General

Quality assurance in the field is probably one of the most slighted aspects of any monitoring QA program. This is especially important since it is here that most errors and inconsistencies are found. All NURP QA programs should adequately address QA in the field. It is especially important that standardized routines be developed and reduced to writing to impart clear understanding to all involved and avoid miscommunication. Such trite phrases as "manual samples shall be obtained using best acceptable procedures" should be avoided, and explicit descriptions used instead. The following discussion only serves to highlight some of the aspects that must be considered. For a discussion of field procedures for flow measurement, sampling, etc., refer to the AAPM.

B. Quality Assurance in Sample Collection

Control checks should be performed during the actual sample collection. These checks are used to determine the performance of the sample collection system. In general, the most common errors produced in monitoring are usually caused by improper sampling, poor preservation, or lack of adequate mixing during compositing and testing. The following checks will help the QA Coordinator to determine when the sample collection system is out-of-control:

1. Duplicate Samples. At selection stations on a random time frame, collect duplicate samples using the field equipment

installed at the site. If automatic sampling equipment is not installed at the site, collect duplicate grab samples. This will provide a proficiency check for precision.

2. Split Samples. Aliquots of the collected sample may be given to other laboratories as a check on the main laboratory procedures. Differences between results can then be evaluated and the cause of the difference usually identified.

3. Spiked Samples. Known amounts of a particular constituent should be added to an actual sample or blanks of deionized water at concentrations where the accuracy of the test method is satisfactory. The amount added should be coordinated with the laboratory. This method will provide a proficiency check for accuracy of the field sampling procedures.

4. Sample Preservative Blanks. Acid and other chemical preservatives can become contaminated after a period of use in the field. The sampler should add the same quantity of preservative to a sample of distilled water as normally would be added to the wastewater sample. This preservative blank is sent to the laboratory for analysis and the blank is subtracted from the sample value. Liquid chemical preservatives should be changed every two weeks or sooner if contamination occurs.

5. Precision, Accuracy, and Control Charts. A minimum of seven sets each of comparative data for duplicates, spikes, split samples and blanks should be collected to define acceptable estimates of precision and accuracy criteria for data validation. See EPA's "Handbook for Analytical Quality Control in Water and Wastewater," or W. J. Youden's

"Statistical Techniques for Collaborative Tests," for discussions of precision, accuracy, and quality control charts and their calculations.

C. Equipment Calibration

When equipment is used in a monitoring program, it must be well maintained and calibrated if readings are to have validity and, therefore, such efforts form an important part of a quality control program. Unfortunately, in view of the wide number of equipment types and designs that might be employed, the only real guidance that can be offered is to follow the manufacturer's directions and specifications. The important thing is that calibration be performed in a systematic fashion and that the results of all calibrations and checks be recorded permanently. The use of equipment tags that indicate when the last calibration was performed and where details of the calibration can be found in the permanent record is usually warranted. With the implication that manufacturer's specifications should always be followed, a few general guidelines for field equipment are given below.

1. Automatic samplers should have all operating aspects checked out in the laboratory before being taken to the field. Equipment used in long-term installations should be checked out at least monthly and often weekly, depending upon design. Superficial checkout and maintenance should be performed whenever samples are collected. For constant aliquot volume type composites, aliquot volume should be verified in the field after installation. Sampling equipment should be recalibrated immediately after use in the field.

2. Flow-measuring devices should be calibrated immediately before and after use in the field. The frequency of developing full range calibration curves will depend upon

the type of device involved. At least three spot checks (one in the lower quarter of range, one near midrange, and one in the upper quarter of range) are usually required to verify a calibration curve established earlier and for large, fixed flow measurement stations.

3. Direct-reading field instruments should be calibrated immediately before and after use in the field. In addition, spot checks should be made at reasonable intervals throughout the sampling schedule.

4. Fixed continuous monitoring devices should be calibrated in the laboratory prior to installation. Wherever possible, results should be verified by approved manual methodology. The calibration of sensors should be checked at least weekly, and preferably on a daily basis.

A calibration plan should be developed and implemented for all field analysis test equipment and calibration standards to include: calibration and maintenance intervals; listing of required calibration standards; environmental conditions requiring calibration; and a documentation record system.

Written calibration procedures should be provided for all measuring and test equipment. A procedure should:

1. Specify where the procedure is applicable, e.g., free residual chlorine by amperometric titration at power plant cooling water effluents.

2. Provide a brief description of the calibration procedure. A copy of the manufacturer's instructions is usually adequate.

3. List calibration standards, reagents, and accessory equipment required.

4. Specify the documentation, including an example of the format used in the field quality assurance log book.

Field equipment should be labeled to indicate the calibration date, when calibration expires and when maintenance is due.

Table I summarizes quality assurance procedures for field analyses generally conducted during sampling inspections.

D. Sample Preservation and Handling

Having collected a representative sample in question, there remains the problem of sample preservation and analysis. It is a practical impossibility either to perform instant analyses of the sample on the spot or to completely and unequivocally preserve it for subsequent examination. Preservative techniques can only retard the chemical and biological changes that inevitably continue following extraction of the sample from its parent source. In the former case, changes occur that are a function of the physical conditions - metal cations may precipitate as hydroxides or form complexes with other constituents; cations or anions may change valence states under certain reducing or oxidizing conditions; constituents may dissolve or volatize with time, and so on. In the latter case, biological changes taking place may change the valence state of an element or radical; soluble constituents may be converted to organically bound materials in cell structures; cell lysis may result in release of cellular material into solution, etc.

Preservation methods are relatively limited and are generally intended to retard biological action, retard hydrolysis of chemical compounds and complexes, and reduce volatility of constituents. They are generally

TABLE I. QUALITY ASSURANCE PROCEDURES FOR FIELD ANALYSIS AND EQUIPMENT

Parameter	General	Daily	Quarterly
1. Dissolved Oxygen			
(a) Membrane Electrode	Enter the make, model, serial and/or ID number for each meter in a log book. Report data to nearest 0.1 mg/1.	(i) Calibrate meter using manufacturer's instructions or Winkler-Azide method. (ii) Check membrane for air bubbles and holes. Change membrane and KCl if necessary. (iii) Check leads, switch contracts, etc. for corrosion and shorts if meter pointer remains offscale.	Check instrument calibration and linearity using a series of at least three dissolved oxygen standards.
(b) Winkler-Azide method	Record data to nearest 0.1 mg/1.	Duplicate analysis should be run as a precision check. Duplicate values should agree within ±0.2 mg/1.	
2. PH - Electrode Method	Enter the make, model, serial and/or ID number for each meter in a log book.	(i) Calibrate the system against standard buffer solutions of known pH value, e.g., 4, 7, and 9 at the start of a sampling run.	Take all meters to the laboratory for maintenance, calibration, quality control [illegible]

TABLE I. QUALITY ASSURANCE PROCEDURES FOR FIELD ANALYSIS AND EQUIPMENT (Cont'd)

Parameter	General	Daily	Quarterly
2. PH (Cont'd)		(ii) Periodically check the buffers during the sample run and record the data in the log sheet or book. (iii) Be on the alert for erratic meter response arising from weak batteries, cracked electrode, fouling, etc. (iv) Check response and linearity following highly acidic or alkaline samples. Allow additional time for equilibration. (v) Check against the closest reference solution each time a violation is found. (vi) Rinse electrodes thoroughly between samples and after calibration.	

TABLE I. QUALITY ASSURANCE PROCEDURES FOR FIELD ANALYSIS AND EQUIPMENT (Cont'd)

Parameter	General	Daily	Quarterly
3. Conductivity	Enter the make, model, serial and/or ID number for each meter in a log book.	(i) Standardize with KCl standards having similar specific conductance values to those anticipated in the samples. Calculate the cell constant using two different standards.	Take all meters to lab for maintenance, calibration and quality control checks.
		Cell Constant = Standard Value/Actual Value	Check temperature compensation.
		Specific Conductance = Reading x Cell Constant	Check date of last platinizing and replatinizing if necessary.
		(ii) Rinse cell after sample to prevent carryover.	Analyze NBS or EPA reference standard and record actual vs observed readings in the log.
4. Residual Chlorine Amperometric Titration	Enter the make, model, ID and/or serial number of each titration apparatus in a log book. Report results to nearest 0.01 mg/l.	(i) Refer to instrument manufacturer's instructions for proper operation and calibration procedures.	Biweekly: Return instrument to lab for maintenance and addition of fresh, standardized reagents.

TABLE I. QUALITY ASSURANCE PROCEDURES FOR FIELD ANALYSIS AND EQUIPMENT (Cont'd)

Parameter	General	Daily	Quarterly
5. Temperature (a) Manual	Enter the make, model, serial number and/or ID number and temperature range for each thermometer. All standardization shall be against a NBS or NBS calibrated thermometer. Readings shall agree within ±1°C. If enforcement action is anticipated calibrate the thermometer before and after analysis. All data shall be read to the nearest 1°C. Report data between 10° - 99°C to two significant figures.	(i) Check for air spaces or bubbles in the column, cracks, etc. Compare with a known source if available.	Biweekly: Check at two temperatures against a NBS or equivalent thermometer. Enter data in a log book. Temperature readings shall agree within ±1°C or the thermometer shall be replaced or recalibrated. Initially and Biannually: Accuracy shall be determined throughout the expected working range 0° to 50°C. A minimum of three temperatures within the range should be used to verify accuracy. Preferable ranges are: 5° - 10°, 15° - 25°, 35° - 45°C.

TABLE I. QUALITY ASSURANCE PROCEDURES FOR FIELD ANALYSIS AND EQUIPMENT (Cont'd)

Parameter	General	Daily	Quarterly
(b) Thermistors; Thermographs, etc.	Enter the make, model, serial and/or ID number of the instrument in a log book. All standardization shall be against a NBS or NBS calibrated thermometer. Readings should agree within ±1°C. If enforcement action is anticipated refer to the procedure listed in 5(a) above.	Check thermistor or sensing device for response and operation according to the manufacturer's instructions. Record actual vs standard temperature in log book.	Initially and Biannually: Accuracy shall be determined throughout the expected working range 0° to 50°C. A minimum of three temperatures within the range should be used to verify accuracy. Preferable ranges are: 5° - 10°, 15° - 25°, 35° - 45°C
6. Flow Measurement	Enter the make, model, serial and/or ID number of each flow measurement instrument in a log book.	Install the device in accordance with the manufacturer's instructions and with the procedures given in Section VI of this manual.	Annually: Affix record of calibration NBS, manufacturer or other, to the instrument log.
7. Automatic Samplers	Enter the make, model, serial and/or ID number of each sampler in a log book.	Inspect equipment for proper functioning, inspect intake and sample transport tubing and clean as required.	Check intake velocity vs head (minimum of three samples), and clock time setting vs actual time interval.

limited to pH control, chemical addition, refrigeration, and freezing. EMSL in its Methods for Chemical Analysis of Water and Waste has compiled a list of recommendations for preservation of samples according to the measurement analysis to be performed. In order to provide an overview for some common parameters, this list has been reproduced here as Table II. For other parameters and program design, reference should be made to the Parameter Handbook of the AAPM.

Proper sample handling is also essential to successful results from any monitoring program. Great pains taken in all other areas may be for nought if samples are accidentally exchanged or otherwise misidentified. The same sample identification system obviously would not be suitable for all types of monitoring programs all across the country, but every program must have one, and it should be thoroughly understood by all involved. A few general guidelines are given below.

1. Each sample container must have a designation, normally a number, that uniquely distinguishes it from all other samples in the program.

2. When frequent sampling over a long time period is involved, consideration should be given to incorporating a temporal indication as a part of the sample identification number; e.g., the number of the week in a year, the last two digits of the year, etc. The temptation to code too much information about the sample into its identification number must be resisted, however, or else the risk of mixups due to unauthorized abbreviations becomes too great.

3. Consideration should be given to the use of preprinted, stickyback labels in many instances. Be certain, however, that they are waterproof.

TABLE II. RECOMMENDATION FOR SAMPLING AND PRESERVATION OF SAMPLES ACCORDING TO MEASUREMENT[1]

Measurement	Vol Req (ml)	Container	Preservative	Holding Time[6]
Acidity	100	P,G[2]	Cool, 4°C	24 Hr
Alkalinity	100	P,G	Cool, 4°C	24 Hr
Arsenic	100	P,G	HNO_3 to pH<2	6 Mo
BOD	1000	P,G	Cool, 4°C	6 Hr[3]
Bromide	100	P,G	Cool, 4°C	24 Hr
COD	50	P,G	H_2SO_4 to pH<2	7 Days
Chloride	50	P,G	None Req	7 Days
Chlorine Req	50	P,G	Det on Site	No Holding
Color	50	P,G	Cool, 4°C	24 Hr
Cyanides	500	P,G	Cool, 4°C NaOH to pH 12	24 Hr
Dissolved Oxygen				
Probe	300	G only	Det on site	No Holding
Winkler	300	G only	Fix on site	4-8 Hr
Fluoride	300	P,G	Cool, 4°C	7 Days
Hardness	100	P,G	Cool, 4°C HNO_3 to pH<2	7 Days
Iodide	100	P,G	Cool, 4°C	24 Hr
MBAS	250	P,G	Cool, 4°C	24 Hr
Metals				
Dissolved	200	P,G	Filter on site HNO_3 to pH<2	6 Mo
Suspended			Filter on site	6 Mo
Total	100		HNO_3 to pH<2	6 Mo

TABLE II. RECOMMENDATION FOR SAMPLING AND PRESERVATION OF SAMPLES ACCORDING TO MEASUREMENT[1] (Cont'd)

Measurement	Vol Req (ml)	Container	Preservative	Holding Time[6]
Mercury				
Dissolved	100	P,G	Filter HNO_3 to pH<2	38 Days (Glass) 13 Days (Hard Plastic)
Total	100	P,G	HNO_3 to pH<2	38 Days (Glass) 13 Days (Hard Plastic)
Nitrogen				
Ammonia	400	P,G	Cool, 4°C H_2SO_4 to pH<2	24 Hr[4]
Kjeldahl	500	P,G	Cool, 4°C H_2SO_4 to pH<2	7 Days
Nitrate	100	P,G	Cool, 4°C H_2SO_4 to pH<2	24 Hr[4]
Nitrite	50	P,G	Cool, 4°C	24 Hr[4]
NTA	50	P,G	Cool, 4°C	24 Hr
Oil and Greese	1000	G only	Cool, 4°C H_2SO_4 or HCl to pH<2	24 Hr
Organic Carbon	25	P,G	Cool, 4°C H_2SO_4 to pH<2	24 Hr
pH	25	P,G	Cool, 4°C Det on site	6 Hr[3]
Phenolics	500	G only	Cool 4°C H_3PO_4 to pH<4 1.0g $CuSO_4$/l	24 Hr

TABLE II. RECOMMENDATION FOR SAMPLING AND PRESERVATION OF SAMPLES ACCORDING TO MEASUREMENT[1] (Cont'd)

Measurement	Vol Req (ml)	Container	Preservative	Holding Time[6]
Phosphorus				
Ortho-phosphate, Dissolved	50	P,G	Filter on site Cool, 4°C	24 Hr[4]
Hydrolyzable	50	P,G	Cool,4°C H_2SO_4 to pH<2	24 Hr[4]
Total	50	P,G	Cool, 4°C	7 Days
Total, Dissolved	50	P,G	Filter on site Cool, 4°C	24 Hr[4]
Residue				
Filterable	100	P,G	Cool, 4°C	7 Days
Non-Filterable	100	P,G	Cool, 4°C	7 Days
Total	100	P,G	Cool, 4°C	7 Days
Volatile	100	P,G	Cool, 4°C	7 Days
Settleable Matter	1000	P,G	None Req	24 Hr
Selenium	50	P,G	HNO_3 to pH<2	6 Mo
Silica	50	P only	Cool, 4°C	7 Days
Specific Conductance	100	P,G	Cool, 4°C	24 Hr[5]
Sulfate	50	P,G	Cool, 4°C	7 Days
Sulfide	500	P,G	2 ml zinc acetate	24 Hr
Sulfite	50	P,G	Det on site	No Holding
Temperature	1000	P,G	Det on site	No Holding

TABLE II. RECOMMENDATION FOR SAMPLING AND PRESERVATION OF SAMPLES ACCORDING TO MEASUREMENT[1] (Cont'd)

Measurement	Vol Req (ml)	Container	Preservative	Holding Time[6]
Threshold Odor	200	G only	Cool, 4°C	24 Hr
Turbidity	100	P,G	Cool, 4°C	7 Days

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[1] More specific instructions for preservation and sampling are found with each procedure as detailed in this manual. A general discussion on sampling water and industrial wastewater may be found in ASTM, Part 23, p. 72-91 (1973).

[2] Plastic or Glass

[3] If samples cannot be returned to the laboratory in less than 6 hours and holding time exceeds this limit, the final reported data should indicate the actual holding time.

[4] Mercuric chloride may be used as an alternate preservative at a concentration of 40 mg/l, especially if a longer holding time is required. However, the use of mercuric chloride is discouraged whenever possible.

[5] If the sample is stabilized by cooling, it should be warmed to 25°C for reading, or temperature correction made and results reported at 25°C.

[6] It has been shown that samples properly preserved may be held for extended periods beyond the recommended holding time.

4. The use of color-coded labels has been successful where sample splitting or different preservation techniques are employed. In the latter case, for example, a green label could indicate that nitric acid had been added and that, therefore, an analyst could obtain aliquots from this sample for metal analyses, etc.

5. The type of sample, date, and any preservatives added should be written on the sample label in the field. Additional information should be noted in the field notebook and on supplemental forms where used.

6. The foregoing should be observed in addition to any chain-of-custody procedures that are involved.

E. Parameters Requiring Special Precautions

1. Organics. Preservatives, holding times, sampling procedures, and sample aliquots or volume for specific organic analysis should be determined prior to each survey after consultation with appropriate lab personnel. The survey leader should provide, if possible, the following information: raw products; chemical processes; and types of wastewater treatment. This will assist the laboratory in making their recommendations regarding sampling and handling procedures. Normally, a one to four liter grab sample, collected in a glass jar with a teflon or cleaned aluminum foil lined screw cap, will provide a sufficient sample volume. Normally, if biological activity cannot be stopped by addition of a preservative, samples should be iced until analysis and received in the laboratory within 24 hours.

2. Acidity - Alkalinity. Compositing of grab samples for acidity, alkalinity, and suspended solids analysis should not be done if a waste discharge varies outside the pH range specified

in NPDES permits. Mixing acid grab samples with neutral or basic grab samples changes the acidity-alkalinity relationship and results in a composite sample which may not be representative of the discharge during the compositing period. The acid-base reaction may also dissolve a portion of the inorganic solids. Thus, a discharge which varies outside the pH range specified in the NPDES permit should be analyzed for acidity, alkalinity and suspended solids on an individual "grab" sample basis.

3. Miscellaneous Parameters. Based on present knowledge, the following parameters should not be collected using automatic samples but should be preserved at the time of sample collection whether the sample is a grab sample or a composite of grab samples.

(a) Dissolved Parameters
Samples should be membrane filtered at the time of collection, if at all possible, and composited if necessary under acidified conditions. In any case, preservation should not be performed until after filtration.

(b) Mercury, Total
Samples for mercury analysis must be acidified at the time of collection. The addition of potassium dichromate will help stabilize dissolved mercury, see El-Awady, et. al.

(c) Phenolics and Cyanides
Simple phenolic compounds and free cyanide may significantly degrade if not preserved at the time of sample collection. If the sample contains residual chlorine, it is also necessary to dechlorinate the sample prior to

preservation. Standard Methods recommends the use of ferrous sulfate as a dechlorination agent for phenolics and ascorbic acid for cyanide.

(d) Sulfide and Sulfite

Table II lists cooling to 4 degrees Centigrade as the preservative for sulfide, while there is no acceptable preservative listed for sulfite and the sample must be analyzed at the time of collection.

VI. CHAIN OF CUSTODY PROCEDURES

Although strict Chain of Custody procedures will in all likelyhood not be warranted for most NURP designated prototype projects, the procedures developed by the USEPA of Enforcement should be thoroughly reviewed and used as a framework for developing sample handling procedures for each project. Recommended Chain of Custody procedures as presented in the USEPA NPDES Compliance Sampling Inspection Manual are presented below.

A. Introduction

As in any other activity that may be used to support litigation, regulatory agencies must be able to provide the chain of possession and custody of any samples which are offered for evidence or which form the basis of analytical test results introduced into evidence in any water pollution case. It is imperative that written procedures be available and followed whenever evidence samples are collected, transferred, stored, analyzed, or destroyed. The primary objective of these procedures is to create an accurate written record which can be used to trace the possession and handling of the sample from the moment of its collection through analysis and its introduction as evidence.

A sample is in someone's "custody" if:

1. It is in one's actual physical possession; or

2. It is in one's view, after being in one's physical possession, or

3. It is in one's physical possession and then locked up so that no one can tamper with it; or

4. It is kept in a secured, area restricted to authorized personnel only.

B. Survey Planning and Preparation

The evidence gathering portion of a survey should be characterized by the conditions stipulated in the permit or the minimum number of samples required to give a fair representation of the wastewater quality. The number of samples and sampling locations, determined prior to the survey, must satisfy the requirements for NPDES monitoring or for establishing a civil or criminal violation.

A copy of the study plan should be distributed to all survey participants in advance of the survey date. A pre-survey briefing is helpful to reappraise survey participants of the objectives, sampling locations and chain of custody procedures that will be used.

C. Sampling Collection, Handling and Identification

1. It is important that a minimum number of persons be involved in sample collection and handling. Guidelines established in this manual for sample collection, preservation and handling should be used. Field records should be completed at the time the sample is collected and should be signed or

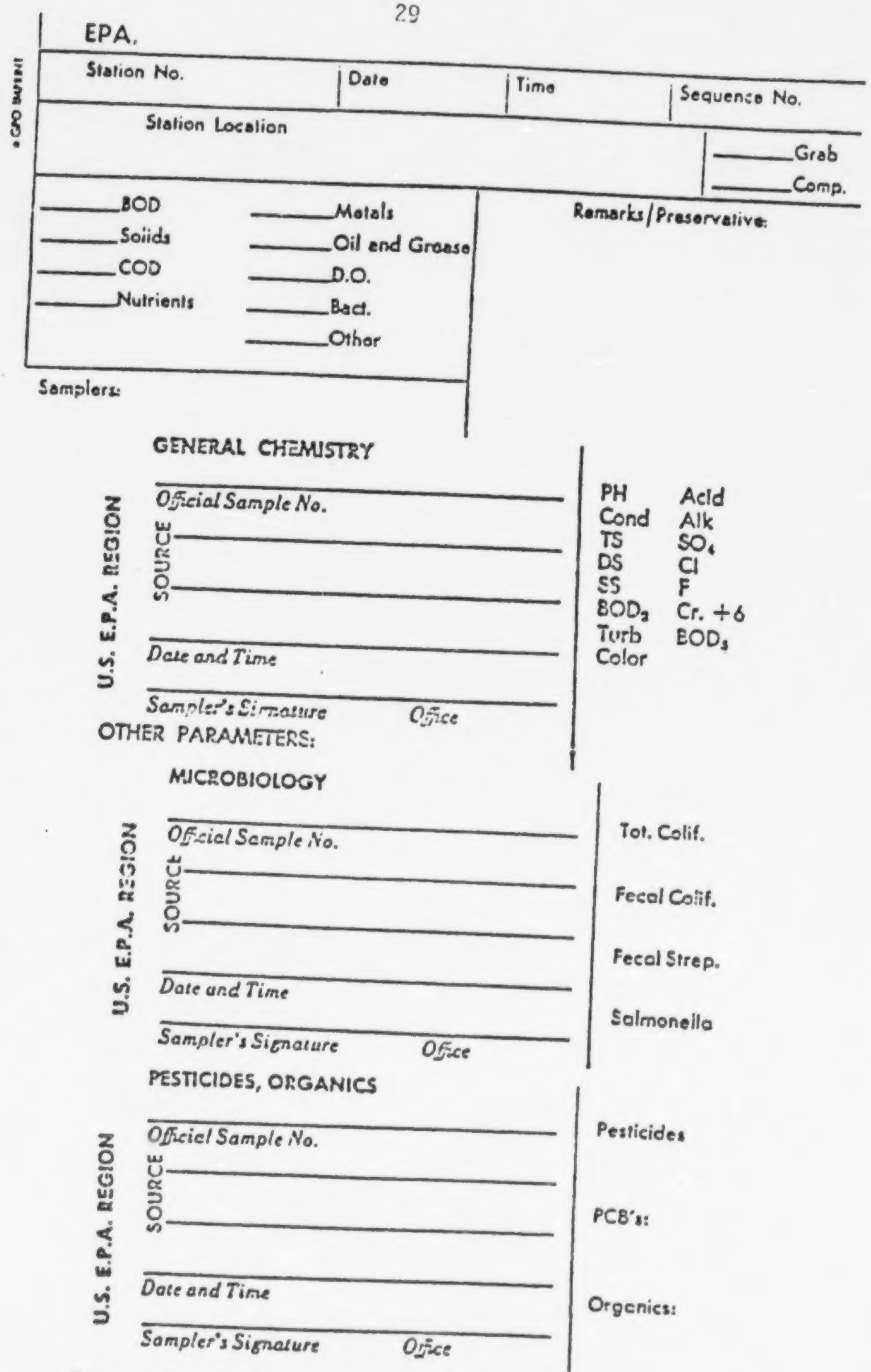
initialed, including the date and time, by the sample collector(s). Field records should contain the following information:

(a) unique sample or log number;
(b) date and time;
(c) source of sample (including name, location and sample type);
(d) preservative used;
(e) analyses required;
(f) name of collector(s);
(g) pertinent field data (pH, DO, Cl residual, etc.);
(h) serial numbers on seals and transportation cases.

2. Each sample is identified by affixing a pressure sensitive gummed label or standardized tag on the container(s). This label should contain the sample identification number, date and time of sample collection, source of sample, preservation used and the collector(s)' initial(s). Analysis required should be identified. Where a label is not available, the same information should be affixed to the sample container with an indelible, water proof, marking pen. Examples of sample identification tags are illustrated in Figure I.

3. The sample container should then be placed in a transportation case along with the chain of custody record form, pertinent field records and analysis request form as needed. All records should be filled out legibly in pen.

The use of the locked and sealed chests will eliminate the need for close control of individual sample containers. However, there will undoubtedly be occasions when the use



• GPO [illegible]

EPA.

Station No. | Date | Time | Sequence No.

Station Location

_______Grab

_______Comp.

_______BOD

_______Solids

_______COD

_______Nutrients

_______Metals

_______Oil and Grease

_______D.O.

_______Bact.

_______Other

Remarks/Preservative:

Samplers:

GENERAL CHEMISTRY

U.S. E.P.A. REGION

Official Sample No.

SOURCE

Date and Time

Sampler's Signature *Office*

OTHER PARAMETERS:

PH	Acid
Cond	Alk
TS	SO_4
DS	Cl
SS	F
BOD_5	Cr. +6
Turb	BOD_5
Color	

MICROBIOLOGY

U.S. E.P.A. REGION

Official Sample No.

SOURCE

Date and Time

Sampler's Signature *Office*

Tot. Colif.

Fecal Colif.

Fecal Strep.

Salmonella

PESTICIDES, ORGANICS

U.S. E.P.A. REGION

Official Sample No.

SOURCE

Date and Time

Sampler's Signature *Office*

Pesticides

PCB's:

Organics:

Figure 1. Sample Identification Tag Examples

of a chest is inconvenient. On those occasions, the sampler should place a seal around the cap of the individual sample container which would indicate tampering if removed.

4. When samples are composited over a time period, unsealed samples can be transferred from one crew to the next crew. A list of samples will be made by the transferring crew and signed for by a member of the receiving crew. They will either transfer the samples to another crew or deliver them to laboratory personnel who will then acknowledge receipt in a similar manner.

5. Color slides or photographs taken of the sample outfall location and of any visible pollution are recommended to facilitate identification and later recollection by the inspector. A photograph log should be made at the time the photo is taken so that this information can be written later on the back of the photo or the margin of the slide. This should include the signature of the photographer, time, date, site location and brief description of the subject of the photo. Photographs and written records, which may be used as evidence, should be handled in such a way that chain of custody can be established.

D. Transfer of Custody and Shipment

1. When transferring the possession of the samples, the transferee must sign and record the date and time on the chain of custody record. Custody transfer, if made to a sample custodian in the field, should account for each individual sample, although samples may be transferred as a group. Every person who takes custody must fill in the appropriate section of the Chain of Custody Record. To prevent undue

proliferation of custody records, the number of custodians in the chain of possession should be as few as possible.

2. The field custodian or field inspector, if a custodian has not been assigned, is responsible for properly packaging and dispatching samples to the appropriate laboratory for analysis.

   This responsibility includes filling out, dating and signing, the appropriate portion of the Chain of Custody Record. A Chain of Custody Record format containing the necessary procedural elements is illustrated in Figure 2.

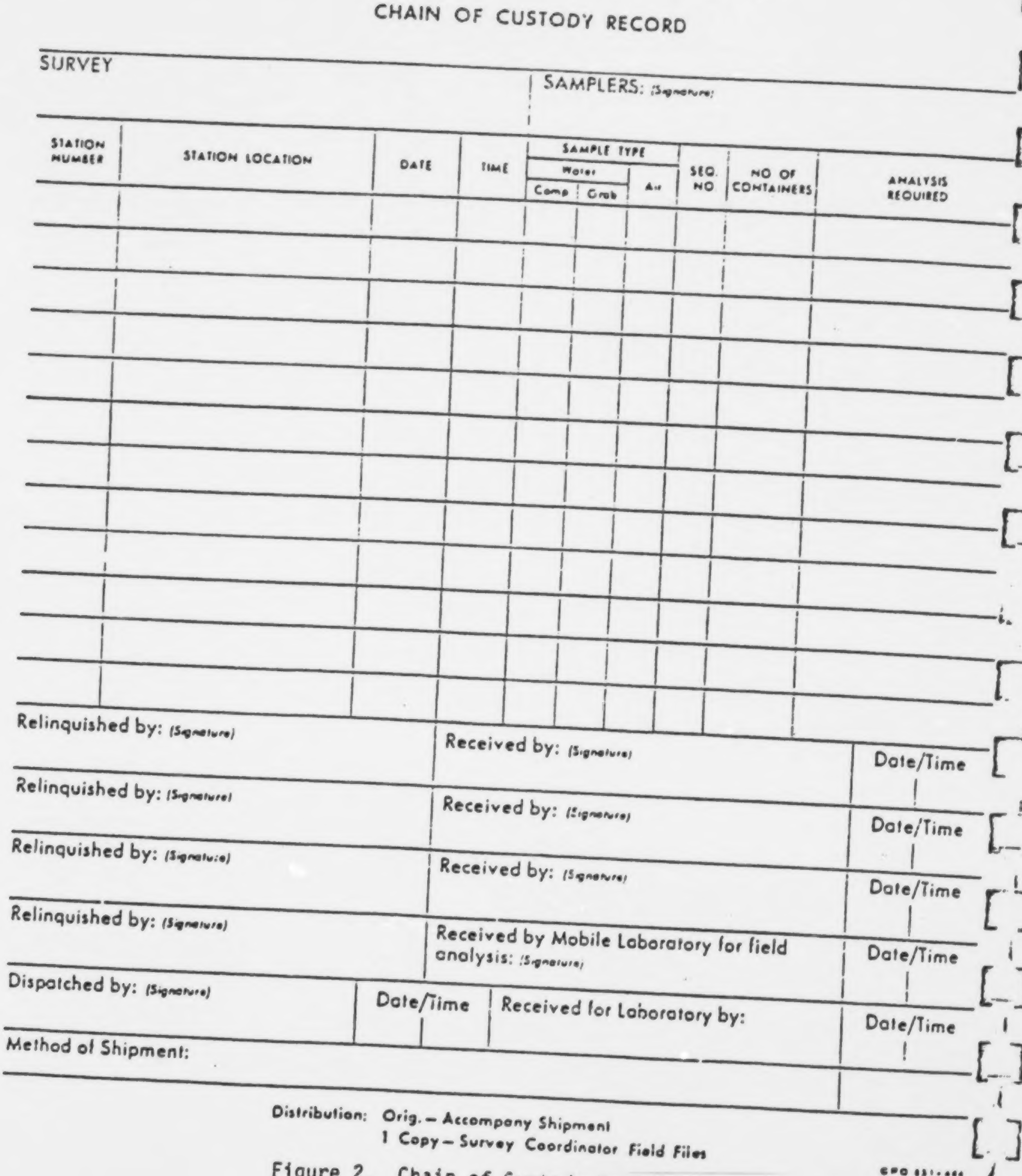
3. All packages sent to the laboratory should be accompanied by the Chain of Custody Record and other pertinent forms. A copy of these forms should be retained by the origination office (either carbon or photo copy).

4. Mailed packages can be registered with return receipt requested. If packages are sent by common carrier, receipts should be retained as part of the permanent chain of custody documentation.

5. Samples to be shipped must be so packed as not to break and the package so sealed or locked that any evidence or tampering may be readily detected.

E. Laboratory Custody Procedures

1. A specific person shall be designated custodian and an alternate designated to act as custodian in the custodian's absence. All incoming samples shall be received by the custodian, who shall indicate receipt by signing the



CHAIN OF CUSTODY RECORD

SURVEY

SAMPLERS: (Signature)

STATION NUMBER	STATION LOCATION	DATE	TIME	SAMPLE TYPE			SEQ. NO	NO OF CONTAINERS	ANALYSIS REQUIRED
				Water		Air			
				Comp	Grab				

Relinquished by: (Signature)	Received by: (Signature)		Date/Time
Relinquished by: (Signature)	Received by: (Signature)		Date/Time
Relinquished by: (Signature)	Received by: (Signature)		Date/Time
Relinquished by: (Signature)	Received by Mobile Laboratory for field analysis: (Signature)		Date/Time
Dispatched by: (Signature)	Date/Time	Received for Laboratory by:	Date/Time
Method of Shipment:			

Distribution: Orig. — Accompany Shipment
1 Copy — Survey Coordinator Field Files

GPO [illegible]

Figure 2. Chain of Custody Record

accompanying custody forms and who shall retain the signed forms as permanent records.

2. The sample custodian shall maintain a permanent log book to record, for each sample, the person delivering the sample, the person receiving the sample, date and time received, source of sample, sample identification or log number, how transmitted to the laboratory and condition received (sealed, unsealed broken container, or other pertinent remarks). A standardized format should be established for log book entries.

3. A clean, dry, isolated room, building, and/or refrigerated space that can be securely locked from the outside shall be designated as a "sample storage security area".

4. The custodian shall ensure that heat-sensitive, light-sensitive samples, radioactive, or other sample materials having unusual physical characteristics, or requiring special handling, are properly stored and maintained prior to analysis.

5. Distribution of samples to the section chiefs who are responsible for the laboratory performing the analyses shall be made only by the custodian.

6. The laboratory area shall be maintained as a secured area, restricted to authorized personnel only.

7. Laboratory personnel are responsible for the care and custody of the sample once it is received by them and shall be prepared to testify that the sample was in their possession and view or secured in the laboratory at all times from the

moment it was received from the custodian until the time that the analyses are completed.

8. Once the sample analyses are completed, the unused portion of the sample, together with all identifying labels, must be returned to the custodian. The returned tagged samples should be retained in the custody room until permission to destroy the sample is received by the custodian.

9. Samples shall be destroyed only upon the order of the Laboratory Director, in consultation with previously designated Enforcement Officials, or when it is certain that the information is no longer required or the samples have deteriorated. The same procedure is true for tags and laboratory records.

F. Evidentiary Considerations

Reducing chain of custody procedures as well as the various promulgated laboratory analytical procedures to writing will facilitate the admission of evidence under rule 803(6) of the Federal Rules of Evidence (PL. 93-575). Under this statute, written records of regularly conducted business activities may be introduced into evidence as an exception to the "Hearsay Rules" without the testimony of the person(s) who made the record. Although preferable, it is not always possible to have the individuals who collected, kept, and analyzed samples testify in court. In addition, if the opposing party does not intend to contest the integrity of the sample or testing evidence, admission under the Rule 803(6) can save a great deal of trial time. For these reasons, it is important that the procedures followed in the collection and analysis of evidentiary samples be standardized and described in an instruction manual which, if need be, can be offered as evidence of the "regularly conducted business activity" followed by the lab or office in generating any given record.

In criminal cases however, records and reports of matters observed by police officers and other law enforcement personnel are not included under the business record exceptions to the "Hearsay Rule" previously cited (see Rule 803(8), P.L. 93-595). It is arguable that those portions of the compliance inspection report dealing with matters other than sampling and analysis results come within this exception. For this reason, in criminal actions records and reports of matter observed by field investigators may not be admissible and the evidence may still have to be presented in the form of oral testimony by the person(s) who made the record or reports, even though the materials come within the definition of business records. In a criminal proceeding, the opposing counsel may be able to obtain copies of reports prepared by witnesses, even if the witness does not refer to the records while testifying, and if obtained, the records may be used for cross-examination purposes.

Admission of records is not automatic under either of these sections. The business records section authorized admission "unless the source of information or the method or circumstances of preparation indicate lack of trustworthiness," and the caveat under the public records exception reads "unless the sources of information or other circumstances indicate lack of trustworthiness."

Thus, whether or not the inspector anticipates that his or her compliance inspection report will be introduced as evidence, he or she should make certain that the report is as accurate and objective as possible.

VII. SAMPLING EQUIPMENT CLEANING

The proper cleaning of all equipment used in the sampling of water and wastewater is essential to ensuring valid results from laboratory analyses. Cleaning protocols should be developed for all sampling equipment early in the design of the monitoring program. Here, also, the laboratory analyst should be consulted, both to ensure that the procedures and techniques are adequate as well as to avoid including practices that are not warranted in view of the analyses to be performed.

As an example, Lair has set down the standard operating procedures for the cleaning of sample bottles and field equipment used by USEPA Region IV Surveillance and Analysis field personnel engaged in NPDES compliance monitoring. They are reproduced below for a typical automatic sampler (manufactured by ISCO) and related sampling equipment.

2-1/2 Gallon Pyrex Glass Composite Bottles

1. Rinse twice with spectro grade acetone.
2. Rinse throughly with hot tap water using a bottle brush to remove particulate matter and surface film.
3. Rinse thoroughly three times with tap water.
4. Acid wash with at least 20-percent hydrochloric acid.
5. Rinse thoroughly three times with tap water.
6. Rinse thoroughly three times with distilled water.
7. Rinse thoroughly with petroleum ether and dry by pulling room air through bottle.
8. Dry in drying oven overnight.
9. Cap with aluminum foil.

ISCO Glass Sampler Bottles

1. One spectro grade acetone rinse.
2. Dishwasher cycle (wash and tap water rinse, no detergent).
3. Acid rinse with at least 20-percent hydrochloric acid.
4. Dishwasher cycle, tap and distilled water rinse cycle, no detergent.
5. Replace in covered ISCO bases.

Sample Tubing (1/4, 3/8, or 1/8 pexcon or tygon)

1. Do not reuse sample tubing. No cleaning required. New sample tubing is to be used for each new sampling setup.

2. Use Teflon tubing where samples for organics are to be collected.

ISCO Pump Tubing

1. Rinse by pumping hot tap water through tubing for at least 2 minutes.

2. Acid wash tubing by pumping at least a 20-percent solution of hydrochloric acid through tubing for at least 2 minutes.

3. Rinse by pumping hot tap water through tubing for at least 2 minutes.

4. Rinse by pumping distilled water through tubing for at least 2 minutes.

Teflon Sample Tubing

1. Teflon sample tubing should be cleaned in the same manner as the 2-1/2-gallon Pyrex sample containers.

ISCO Rotary Funnel and Distributor

1. Clean with hexane to remove any grease deposits.

2. Rinse thoroughly with hot water and a bottle brush to remove particulate matter and surface films.

3. Use a squeeze bottle of 20-percent hydrochloric acid and rinse thoroughly, rinse funnel as well as funnel and distributor depressions.

4. Rinse thoroughly with tap water.

5. Rinse thoroughly with distilled water.

6. Replace in sampler.

ISCO Sample Headers

1. Rinse entire header with hexane or petroleum ether.

2. Disassemble header and rinse thoroughly with hot tap water, using a bottle brush to remove particulate matter and surface films.

3. Rinse the plastic portion of the header with at least a 20-percent solution of hydrocholoric acid. Do not use acid on the metal parts.

4. Rinse thoroughly with tap water.

5. Reassemble header.

6. Rinse all header parts thoroughly with distilled water.

One-Gallon Plastic Sample Containers

1. Use only new bottles when sampling wastewater sources.

One-Quart Wide-Mouth Bottles for Organics, Pesticides, Oil, and Grease Samples

1. Use only new bottles with Teflon liners.
2. Rinse twice with petroleum ether and allow to dry.

One-Pint Narrow-Mouth Bottles for Phenol Samples

1. Use new bottles only.

One-Pint Narrow-Mouth Mercury Sample Bottles

1. Use only new bottles.
2. Rinse with at least 20-percent nitric acid.
3. Rinse at least three times with distilled water.

One-Liter Plastic Storemore Cyanide Sample Bottles

1. Use only new bottles.

VIII. QUALITY ASSURANCE COSTS

It is impossible to provide absolute cost estimates in dollars for a quality assurance program. Cost/manpower ratios can be used, however, to help in estimating or determining if resource allocations are in balance to ensure that the necessary emphasis is being placed on quality control.

In terms of management budgets, a cost ratio of approximately 10 percent monies/manpower to total monitoring budget indicates that there is a sufficient response to develop a minimal water quality assurance program. This is an average figure since resources will vary according to the stage of the program and to the program work schedule. In addition, it should be recognized that individual elements of the overall quality assurance effort will vary with time and with phases of the program, i.e., management, field sampling laboratory analysis, data handling, etc. For programs where there is considerable emphasis on litigation data, quality control cost ratios of one-third or more might be appropriate. Average ratios for a rather complete quality assurance program will usually fall in the 15- to 20-percent range.

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APPENDIX B

PRIORITY POLLUTANTS

APPENDIX B

PRIORITY POLLUTANTS

I. PESTICIDES

1. Acrolein
2. Aldrin
3. a-BHC
4. B-BHC
5. Y-BHC
6. S-BHC
7. Chlordane
8. DDD
9. DDE
10. DDT
11. Dieldrin
12. a-Endosulfan
13. A-Endosulfan
14. Endosulfan sulfate
15. Endrin
16. Endrin aldehyde
17. Heptachlor
18. Heptachlor epoxide
19. Isophorone
20. TCDD (2,3,7,8-tetrachlorodibenzo-p-dioxin)
21. Toxaphene

II. METALS AND INORGANICS

1. Antimony
2. Arsenic
3. Asbestos
4. Beryllium
5. Cadmium
6. Chromium
7. Copper
8. Cyanides
9. Lead
10. Mercury
11. Nickle
12. Selenium
13. Silver
14. Thallium
15. Zinc

III. PCB'S AND RELATED COMPOUNDS

1. PCB-1016 (Arochlor 1016)
2. PCB-1221 (Arochlor 1221)
3. PCB-1232 (Arochlor 1232)
4. PCB-1242 (Arochlor 1242)
5. PCB-1248 (Arochlor 1248)
6. PCB-1254 (Arochlor 1254)
7. PCB-1260 (Arochlor 1260)
8. 2-Chloronaphthalene

IV. HALOGENATED ALIPHATICS

1. Methane, bromo- thyl bromide
2. Methane, chloro- (methyl chloride)
3. Methane, dichloro- (methylene chloride)
4. Methane, chlorodibromo-
5. Methane, dichlorobromo-
6. Methane, tribromo- (promoform)
7. Methane, trichloro- (chloroform)
8. Methane, tetrachloro- (carbon tetrachloride)
9. Methane, trichlorofluro-
10. Methane, dichlorodiflouro-
11. Ethane, chloro-
12. Ethane, 1, 1-dichloro-
13. Ethane, 1, 2-dichloro-
14. Ethane, 1, 1, 1-trichloro-
15. Ethane, 1, 1, 2-trichloro-
16. Ethane, 1, 1, 2, 2-tetrachloro-
17. Ethane, hexachloro-
18. Ethene, chloro- (vinyl chloride)
19. Ethene, 1, 1-dichloro-
20. Ethene, 1, 2-trans-dichloro-
21. Ethene, trichloro-
22. Ethene, tetrachloro-
23. Propene, 1, 2-dichloro-
24. Propene, 1, 3-dichloro-
25. Butadiene, hexachloro-
26. Cyclopentadiene, hexachloro-

V. ETHERS

1. Ether, bis(chloromethyl)-
2. Ether, bis(chloroethyl)-
3. Ether, bis(2-chlorisopropyl)-
4. Ether, 2-chlorethyl vinyl-
5. Ether, 4-bromophenyl phenyl-
6. Ether, 4-chlorophenyl phenyl-
7. Bis (2-chloroethoxy) methane

VI. MONOCYCLIC AROMATICS (EXCLUDING PHENOLS, CRESOLS, PHTHALATES)

1. Benzene
2. Benzene, chloro-
3. Benzene, 1, 2-dichloro-
4. Benzene, 1, 3-dichloro-
5. Benzene, 1, 4-dichloro-
6. Benzene, 1, 2, 4-trichloro-
7. Benzene, hexachloro-
8. Benzene, ethyl-
9. Benzene, nitro-
10. Toluene
11. Toluene, 2, 4-dinitro-
12. Toluene, 2, 6-dinitro-

VII. PHNEOLS AND CRESOLS

1. Phenol
2. Phenol, 2-chloro-
3. Phenol, 2,4-dichloro-
4. Phenol, 2,4,6-trichloro-
5. Phenol, pentachloro-
6. Phenol, 2-nitro-
7. Phenol, 4-nitro-
8. Phenol, 2,4,-dinitro-
9. Phenol, 2,4-dimethyl-
10. M-Cresol, p-chloro-
11. O-Cresol, 4,6-denitro-

VIII. PHTHALATE ESTERS

1. Phthalate, dimethyl
2. Phthalate, diethyl
3. Phthalate, di-n-butyl
4. Phthalate, di-n-octyl
5. Phthalate, bis (2-ethylhexyl)
6. Phthalate, butyl benzyl

IX. POLYCYCLIC AROMATIC HYDROCARBONS

1. Acenaphthene
2. Acenaphthylene
3. Anthracene
4. Benzo(a)anthracene
5. Benzo(b)fluoranthene
6. Benzo(k)fluoranthene
7. Benzo(g.h.i.)Perylene
8. Benzo(a)pyrene
9. Chrysene
10. Dibenzo(a.h.)anthracene
11. Fluoranthene
12. Fluorene
13. Indeno(1,2,3-c,d)pyrene
14. Naphthalene
15. Phenanthrene
16. Pyrene

X. NITROSAMINES AND OTHER NITROGEN-CONTAINING COMPOUNDS

1. Nitrosamine, dimethyl-(DMN)
2. Nitrosamine, diphenyl-
3. Nitrosamine, di-n-propyl-
4. Benzidine
5. Benzidine, 3,3'-dichloro-
6. Hydrazine, 1,2-diphenyl-
7. Acrylonitrile

APPENDIX C

PUBLIC PARTICIPATION

APPENDIX C

III. PUBLIC PARTICIPATION (April - June, 1980)

Summarize quarterly public participation activities on attached chart and submit to regional office.

	Date	Time	Place	Number Involved	*Rating			Amount
					G	F	P	
PAC MEETING	5/20	9-11	Metroplan	33	X			
INTER-AGENCY MEETING	(see attached schedule)							
RADIO SPOTS	4/30		All local stations		X			
TV SPOTS	N/A							
TALK SHOW	5/5, 5/13		ARN, KTHV	2,3	X			
FILM STRIPS	5/20, 6/25		Metroplan	33,10	X			
TOWN MEETINGS	N/A							
PRESS RELEASES	4/28, 4/28		Release on project, release on advisors					
PRESS CONFERENCES	4/28	1:30	Metroplan	15	X			
FEATURE ARTICLE	N/A							
EDITORIAL	N/A							
DEPOSITORIES	Continuous update of 6 depositories in Pulaski/Saline							
NEWSLETTER	6/1							
EXHIBITS	N/A							
PUBLICATION	NURP summary with map							
SPEECHES	6/25	1:30	Metroplan	10	X			
SPECIAL EVENTS	5/17	All Day	UALR	50	X			
TV INTERVIEWS	5/17							
RADIO INTERVIEWS	5/20, 5/31							

*G - Good
F - Fair
P - Poor

III. PUBLIC PARTICIPATION (July - September, 1980)

Significant meetings at which the Fourche Creek Urban Runoff Project was discussed:

7-2	Arkansas Department of Pollution Control and Ecology
7-7	Robert Hart, Arkansas Department of Health
7-10	Jerry Hill, Arkansas Department of Health
7-14	Ann Hartley, Dallas EPA
7-15	Mike Beatie, Little Rock Community Services
7-22	Jerry Hill, Arkansas Department of Health
8-5	Mike Beatie, Little Rock Community Services
8-12	Pulaski Conservation District Board
8-14	Arkansas Department of Pollution Control and Ecology
8-15	John Shelby, University of Arkansas at Little Rock
8-19	Environmental Advisory Committee
8-21	Bill Buntin, Little Rock Parks and Recreation
8-26	Randy Young, Arkansas Soil and Water Conservation Commission
8-26	Jerry Gardner, Little Rock Wastewater Utility
8-27	Julius Breckling, Little Rock Parks and Recreation
9-3	Dallas EPA
9-8	Jerry Gradner, Little Rock Wastewater Utility
9-8	Neil Cook, U.S. Soil Conservation Service
9-9	Arkansas Department of Pollution Control and Ecology
9-15	Bill Caruthers, Contractor
9-15	Ben Hogan, Contractor
9-26	Bill Buntin, Little Rock Parks and Recreation

III. Public Participation (October - December 1980)

Significant meetings at which the Fourche Creek Urban Runoff Project was discussed:

10- 1	Marie Flickinger, Pulaski County Planning Office
11-10	Mike Batie, Little Rock Community Services
11-13	Carl McChesney, Pulaski County Planning Office
11-20	John Lowery, 3M Company
11-21	Julius Breckling, Little Rock Parks and Recreation
11-24	Mike Batie, Little Rock Community Services
11-25	Joyce Sadler, ADPC&E
12-11	Rocky Herman, Little Rock Parks and Recreation
12-11	Mike Batie, Little Rock Community Services
12-11	Marie Flickinger, Pulaski County Planning Office

III. Public Participation (January - March, 1981)

Summary of the Quarter

The quarterly meeting of the 208 Water Quality Advisory Committee was held February 26, during which a progress report of the Fourche Creek Nationwide Urban Runoff Program was given and questions answered. A press release including information about the NURP project was written and sent two weeks in advance of the meeting. Follow-up radio interviews were conducted which included NURP information, and a meeting summary was prepared and sent to over 100 people.

On February 27 a tour of the NURP project area was given to Roger Hartung and Ann Hartley from the U. S. Environmental Protection Agency.

The NURP program was discussed at a 208 Planning Task Force meeting held at UALR on February 25 which included participants from local, state and federal agencies involved in 208 planning. Information regarding the program was distributed to interested individuals.

An Urban Stormwater Runoff Workshop was attended in Fayetteville at which a short presentation was given to over 100 people concerning the Fourche Creek NURP project. Pamphlets containing information were distributed, and interested participants were added to the NURP mailing list.

A large amount of time has been spent preparing for the tour of the NURP project area. The NURP subcommittee, City Board of Directors, and other key city officials are among the listing of participants. The tour, tentatively planned for

May, will include a 3-hour bus tour, discussion papers, presentations, and lunch at Boyle Park. Representatives of the media will be invited to attend and radio interviews and a feature article will appear prior to the tour.

The monthly newsletter, Metroplanner, with a circulation of approximately 1,200, has carried monthly articles on NURP. A feature article recently appeared in the Recreational News newsletter published in Little Rock. All information depositories have been kept up to date.

In addition, NURP was discussed at the following major meetings:

1-22: Joyce Sadler, ADPC&E
1-23: Mike Batie, LR Community Services
2-3: Dr. Richard Hanson, UALR Chemistry Dept.
2-5: Bill Buntin, LR Parks and Recreation Dept.
2-9: Mike Batie, LR Community Services
3-10: Mike Batie, LR Community Services
3-30: Mike Batie, LR Community Services

III. Public Participation

	DATE	PLACE	RATING	PERSONS INVOLVED
CAC MEETING	2/26	Metroplan	Excellent	40
INTER-AGENCY MEETINGS	1/22, 1/23, 2/3, 2/5, 2/9, 3/10, 3/30	(See attached written text)		
RADIO SPOTS	NA this quarter			
TV SPOTS	NA this quarter			
TALK SHOW	NA this quarter			
SLIDE SHOW	NA this quarter			
TOWN MEETINGS	NA this quarter			
PRESS RELEASES	2/23	Gazette	Excellent	
PRESS CONFERENCES	NA this quarter			
FEATURE ARTICLE	Fall & Winter, 1981	Recreational News,	Excellent	
EDITORIAL	NA this quarter			
DEPOSITORIES	(Constant mailings to all depositories)			
NEWSLETTER	1/81, 2/81, 3/81	Metroplanner	Excellent	
EXHIBITS	NA this quarter			
PUBLICATION	NA this quarter			
TV INTERVIEWS	2/26	Metroplan & Channels 11 and 4	Excellent	
RADIO INTERVIEWS	2/26	Radio KARN	Excellent	
LEGAL NOTICE	NA this quarter			

III. Public Participation (April - June, 1981)

Summary of the Quarter

The Governor's Conference on Citizen Participation was held April 3 during which the NURP program for Fourche Creek was discussed with other local, state, and federal agency representatives. The NURP was also discussed at the working for Clean Water in Arkansas Workshop held May 19 at UALR.

Alan Plummer, EPA consultant for NURP, visited Metroplan with Ann Hartley from EPA to discuss the NURP progress. A day was spent touring the BMP sites and evaluating the project.

The quarterly meeting of the 208 Citizen Advisory Committee was held June 24 during which the NURP subcommittee met to discuss the project and elect a subcommittee chairperson. The subcommittee is eager to become more involved in the project and scheduled another subcommittee meeting for July 28. At this meeting, a tour of the BMP sites will be conducted and problem areas will be discussed.

Prior to this meeting, meeting notices were sent to the CAC and to the mailing list, and press releases were mailed to the newspapers, radio stations, and television stations. Following the meeting, interviews were conducted by two television stations (channels 4 and 7). Channel 7 flew in a helicopter over Fourche Creek showing the project area and an in-depth interview of the NURP project followed. Channel 4's coverage involved an interview discussing the NURP project. An interview about NURP was also conducted on KARN radio station following the meeting. A meeting summary was prepared and sent to the CAC and to the mailing list.

News articles concerning NURP appeared in the monthly newsletter, Metroplanner, and all NURP information depositories have been kept up to date.

In addition, the following significant meetings for NURP took place:

4-6-81	Mike Batie, LR Community Services
4-6-81	Bill Buntin, LR Parks and Recreation
4-21-81	Mike Batie
4-21-81	Bill Buntin
5-27-81	R. C. Wilson, ADPC&E
6-9-81	R. C. Wilson

Public Participation

Summary of the Quarter (July - September, 1981)

A meeting of the Fourche Creek Nationwide Urban Runoff subcommittee was held July 28. The Metroplan staff reviewed with the subcommittee the water sampling data from the Fourche Creek system. An agenda was prepared prior to the meeting and a summary was mailed to committee members and to the 208 information depositories. A tour of the BMP sites along Fourche Creek's tributaries was scheduled for the committee members following the meeting.

The quarterly meeting of the 208 Citizen Advisory Committee was held August 25, during which a complete progress report on NURP was given and questions answered. A press release was prepared which included a review of NURP to date. A radio interview was given after the meeting. A meeting summary was prepared and the information depositories were kept up to date.

The 208 project officer, Ann Hartley, and the non-point source coordinator, Ben Longoria, both participated in BMP tours during the quarter.

In August, the Metroplanner, reported on the progress of NURP.

In addition, Phase II of NURP was discussed at the following meetings:

7-13-81	Earl Paul, Baptist Hospital
7-29-81	Dick Hanson, UALR Chemistry Department
7-29-81	Hugh Teaford, Teaford Engineering
8-13-81	Bill Buntin, LR Parks and Recreation
8-19-81	Hugh Teaford, Teaford Engineering
8-20-81	Joey Clark, UALR Department of Chemistry

III. Public Participation

Summary of the Quarter (October - December, 1981)

Reorganization of the 208 Citizens Advisory Committee has added four new members to the Fourche Creek National Urban Runoff subcommittee. Their names and the community interest they represent are as follows: Marty Clark, Conservation Education Association; Mel White, Pulaski County Audubon Society; Alice Andrews, Ozark Society; and Jerry Gardner, Manager, Little Rock Wastewater Utility. A tour of the BMP sites along Fourche Creek's tributaries was arranged to help familiarize the new members with the scope of the project.

A meeting of the NURP subcommittee was held November 18. A notice and agenda were mailed prior to the meeting and a summary was prepared afterwards. The Metroplan staff gave a brief review of NURP and indicated on a map the location of each BMP site and the method used. Installation of gabions on Grassy Flat Creek at Old Forge is scheduled for completion by the end of January, 1982. A slide presentation showing the work completed on Coleman Creek at War Memorial Park was made. The subcommittee agreed that this site was the best example of effective erosion control measures and that the community should be made aware of the improvements. Arrangements were made to place a sign beside the stream naming the cooperating agencies responsible for the improvements.

Posting to warn the public of the stream's contamination will be carried out. At the NURP subcommittee meeting a resolution was introduced which directs Metroplan to meet with the Little Rock City Board of Directors and the City Parks Department to develop a program informing the public of the stream pollution.

At the quarterly meeting of the 208 CAC on December 16, the Fourche Creek Resolution was adopted by the committee. Prior to this meeting a press release was prepared which included a review of the NURP project. A meeting summary was prepared and the information depositories were kept up to date.

The October and December Metroplanner reported on the progress of NURP. Subsequently, in October, 1981, the Arkansas Gazette and the Arkansas Democrat ran feature articles on the potentially dangerous bacteria problem in the Fourche Creek tributaries.

In addition, Phase II of NURP was discussed at the following meetings:

10-21-81	Joey Clark, UALR Department of Chemistry
11-16-81	Hugh Teaford, Teaford Engineering Associates
12-3-81	Clay Chesney, Soil and Water Conservation Commission

III. PUBLIC PARTICIPATION

Summary of the Quarter (January - March, 1982)

The NURP subcommittee met February 17 at 10 a.m. in the ninth floor conference room of the Wallace Building. Dan Reikes, the new director of the 208 program in Fort Smith, Arkansas attended the meeting and afterward was given a tour of the BMPs sites.

The subcommittee approved the sign which will be posted in the parks along the Fourche Creek system. The sign warns the public of the stream's contamination and advises against bodily contact. The Little Rock Parks Department has agreed to begin posting the streams in April. The coinciding public information campaign will also begin in April involving extensive coverage by all the media.

On March 2 and 3, the 208 staff attended the non-point source workshop sponsored by the Arkansas Department of Pollution Control and Ecology. Reference to NURP was made throughout the conference and the 208 staff answered several questions.

The January/February Metroplanner carried a feature article on the future direction and alternative funding sources of the 208 Water Quality Management Plan. There was good public response to the article. The Arkansas Gazette (16 February 1982) ran a photo essay on the improvements to Coleman Creek in War Memorial Park, and we expect an extensive follow-up article once the warning signs are posted in the park.

In addition, Phase II, of NURP was discussed at the following meetings:

1-08-82 Mike Batie, City of Little Rock

1-20-82 Bill Russom, City of Little Rock

1-21-82 Ann Hartley, EPA Dallas

1-28-82 Joey Clark, UALR Chemistry Department

2-17-82 Gerald Hanson, UALR

3-03-82 Jim Meek, EPA Washington

3-24-82 Jarrell Southall, Department of Pollution Control and Ecology

III. PUBLIC PARTICIPATION

Summary of the quarter (April - June, 1982)

The 208 Citizen's Advisory Committee met April 7 in the ninth floor conference room of the Wallace Building. At the meeting, the Fourche Creek posting campaign was outlined. The press attending found this particularly interesting and featured articles in the Democrat (April 4, 1982) and channel 4 TV interviewed Dr. Covington. Also, an article appeared in the June Metroplanner.

Fifteen local civic organizations received information regarding the posting campaign and were asked to reprint the information in their newsletters. The Little Rock public schools put an announcement on channel 19 (cable TV) which will be aired 24 hours a day. Fifty per cent of the signs have been erected in selected park areas. In addition, Mr. Hugh Meindl, Director of the water quality program in Nederland, Texas, requested a photocopy of the warning sign. He hopes to initiate a similar program in his area.

On April 27, a presentation was made to the Pulaski County Planning Board regarding the posting campaign. The program was presented and questions answered.

The NURP subcommittee met May 26. Since the approval of Metroplan's integrated planning program, the NURP subcommittee was assigned the responsibility of selecting services which Metroplan can provide the community under the program. Julius Breckling of the City Parks Department, a guest speaker at the meeting, commented on the exiting relationship between the Parks Department and Metroplan. Mr. Breckling and the Parks Department assisted us with the Fourche Creek sign posting and said he supported any further efforts which coordinated and improved services to the community.

When Dennis Athayde visted from EPA Washington, he was given an extensive tour of all the BMP sites.

In addition, phase II of the NURP project was discussed at the following meetings:

5-22-82	Mike Batie, City of Little Rock
5-25-82	Dennis Athayde, Washington, EPA
5-26-82	Julius Breckling, City of Little Rock
6-17-82	Bill Buntin, City of Little Rock
6-17-82	Julius Breckling, City of Little Rock

III. PUBLIC PARTICIPATION
July - September, 1982

On August 25, 1982 Metroplan held a public meeting and a Citizen Advisory Committee meeting at the University of Arkansas at Little Rock Conference Center. Among other purposes, the Advisory Committee meeting was used to review progress on the Fourche Creek Urban Runoff Project. The Construction and Urban Runoff Subcommittee discussed the urban runoff project more fully. Andy Covington of the Metroplan staff met with the subcommittee chaired by Gerald Hanson to answer questions.

In addition to the public meeting and Advisory Committee meeting the following consultations were held:

7-2-82	Dick Hanson, Joey Clark at UALR
7-7-82	Mike Batie at Little Rock Public Works
7-8-82	Bill Buntin at Little Rock Parks and Recreation
7-20-82	Cynthia Shackleford, tour of BMP sites
7-23-82	Hugh Teaford, Bill Buntin, Ken Sites at LR Parks
7-30-82	Mack Faulkner, Bill Buntin at ADPC&E
8-10-82	Hugh Teaford, Mike Batie, Julius Breckling at Metroplan
8-11-82	Hugh Teaford, Joey Clark, Dick Hanson at UALR
8-24-82	Hugh Teaford, Dick Hanson at Metroplan
9-16-82	Mike Batie at Metroplan
9-29-82	Bill Buntin, Rocky Herman, Julius Breckling, Dennis Burkes at Little Rock Parks

Summary of the quarter (October - December, 1982)

A meeting of the Fourche Creek Nationwide Urban Runoff (NURP) subcommittee was held October 27. At the meeting, a slide show was presented illustrating the projects using BMPs in western Little Rock. An agenda was prepared prior to the meeting and a summary was mailed to the subcommittee members and to the 208 information depositories.

The quarterly meeting of the 208 Citizen Advisory Committee was held December 8, during which a progress report on NURP was given and questions answered. Gerald Hanson, chairman for the committee on Urban Runoff said that the subcommittee had agreed to have the urban runoff controls and recommendations which emerged from NURP reviewed by interested parties,e.g., the Home Builders, engineers and contractors, and then presented to the city directors for their consideration. It is hoped that these recommendations will lend support towards additional efforts being made by the city to reduce runoff pollution. A meeting summary was prepared and the information depositories were kept up to date.

In addition to the public involvement activities outlined above, routine meetings were conducted with the following agencies and individuals:

Hugh Teaford, Teaford Engineering Associates, consultant
Dr. Richard Hanson, UALR Department of Chemistry, sampling
Joey Clark, UALR Department of Chemistry, sampling
Julius Breckling, LR Parks, BMP evaluation
Bill Buntin, LR Parks, BMP evaluation
Rocky Herman, LR Parks, BMP evaluation
Mike Batie, LR Public Works, BMP evaluation
Cynthia Shackleford, ADPC&E, program review
Rich Garrett, ADPC&E, program review
Dennis Burks, LR Wastewater Utility, BMP evaluation

III. PUBLIC PARTICIPATION

Summary of the quarter (January - March, 1983)

Metroplan held its Annual Meeting January 21, 1983. At the meeting, three individuals were commended for their efforts in preserving and restoring the environmental quality of the Little Rock-North Little Rock metropolitan area.

ALCOA received an award in the corporate category for directing its Arkansas branches to restore mined bauxite lands to a crop-sustaining state. Robert Hornbeck of Pittsburg, Pennsylvania accepted the award.

Julius Breckling, director of Little Rock's Parks and Recreation Department was commended for his work with experimental landscaping techniques to reduce pollution runoff in city parks. Sharon Priest, a member of the City Beautiful Commission was honored for her work on the proposed excavation ordinance and for leading a petition campaign for support of a federal flood control plan.

The 208 CPP subcommittees met during February. Meeting notices and agendas were mailed to each subcommittee member and the 208 information depositories. Meeting summaries were prepared afterwards.

On February 23, the mining/silvicultural runoff subcommittee met to discuss various 208 projects. Dr. Jarvis Harper, a research agronomist with ALCOA, made a presentation on ALCOA's land reclamation project. Dr. Harper used slides to illustrate the land in various stages of recovery and answered questions about the project. The subcommittee members requested a tour of the bauxite areas. Dr. Harper and Kimberly Woods of Metroplan agreed to make the necessary arrangements.

On Febrary 28, the agricultural/septic tank runoff subcommittee met to discuss the agriculture project in eastern Pulaski County and other subcommittee projects. Richard Magee, an urban planner with Metroplan outlined the project's objectives and answered questions.

In addition, the 208 subcommittees are reviewing Little Rock's draft excavation ordinance. A letter of support from the entire 208 Citizen Advisory Committee will be prepared and forwarded to Little Rock's Board of Directors.

Articles about the 208 programs appear regularly in Metroplan's monthly newsletter. It has a circulation of approximately 1,100 persons nationwide. All 208 information depositories have been kept up to date.

In addition, the forestry and mining projects were discussed at the following meetings:

Janurary 5	Mike Batie, City of Little Rock
January 11	Jarvis Harper, ALCOA
January 20	Ed Miller, Weyerhaeuser
January 24	Jim Shell, ADPC&E
February 2	Rocky Herman, City of Little Rock
February 9	Merf Pavlovitch, Forestry Association
February 17	Randall Leister, Arkansas Forestry Commission
February 28	Bill McNish, ALCOA
March 1	Roger Nelson, Reynolds
March 16	Ed Miller, Weyerhaeuser

ARKANSAS
GAZETTE
10/29/81

Bacterial Counts In Creeks Alarm Metroplan Official

When it rains, the fecal bacteria count in Fourche Creek and its tributaries is 50 to 100 times higher than the state's standards for such streams, Andy Covington, Metroplan's director of management planning, said Wednesday.

Covington said signs should be posted at the streams to warn people that they shouldn't play in the streams or drink the water. He said both the state Pollution Control and Ecology Department and the state Health Department have refused to post the streams, but that the city Parks and Recreation Department might post warnings near those that run through city parks.

Metroplan has taken more than 250 samples of water from Fourche, Rock, Coleman and Grassy Flat Creeks in the last year. Some samples taken during wet weather show bacteria counts as high as 100,000 per 100 milliliters of water. In dry weather, the count may drop as low as 200 per 100 milliliters of water.

The bacteria themselves may not be dangerous, Covington said in an interview later, but they are "an indication that conditions that could support disease are present."

Covington said the Health Department wouldn't post the streams because they aren't used as drinking water supplies. He said the Pollution Control and Ecology Department wouldn't post the streams because "they're concerned about public outcry and don't want to alarm the public." He said the Department says the "problem can't be fixed, so there is no need to do it until someone gets sick."

Covington agreed that there apparently was no way to reduce the fecal count. He said the problem apparently exists in city streams throughout the world, and probably can be attributed to rain washing animal waste into the waterways.

Covington made his remarks during a meeting of the Metroplan Board of Directors while making a report on the progress of a federally funded study about sources and control of urban runoff.

In an interview later, Jarrell Southall, director of the Pollution Control and Ecology Department, said he was unaware of any request being made for his Department to post signs at streams. He said it might be Metroplan's responsibility since it's managing the runoff study.

Southall, too, said it wasn't uncommon for streams to have high fecal bacteria counts during and after a rain, particularly in urban areas. He said that the fecal count increases after rains even in "pristine" areas. He said he wasn't sure if there was any significance in the fact that there was a high level of bacteria in Little Rock's streams during rains. However, he said he would talk to Covington about the matter.

After Covington's report Wednesday, the Metroplan Board took these actions:

★ Adopted a resolution endorsing an environmental impact study that recommends improvements to the Adams Field sewage treatment plant, but took exception to comments in the study that suggested the city should not expand its sewer capacity in northwest Little Rock. The city Sewer Committee has adopted a similar resolution.

★ Adopted a 1982 budget that provides a 7 per cent increase in salary for Metroplan employes. The budget totals $1,114,864. The portion paid by local governments is only $128,281. The rest comes from various federally funded programs.

1203

ARK DEMOCRAT
10/29/81

1204

Public ignorant of creek's danger, official says

By JAMES MERRIWEATHER
Democrat Staff Writer

State officials have been aware of a potentially dangerous bacteria problem in Fourche Creek and its tributaries but have failed to tell the public about it, a Metroplan official said Wednesday.

"The state knows about it, but it doesn't want to inform the public unless somebody gets sick," Andy Covington, Metroplan's director of management planning, said. "They just don't want to inform the public because there is nothing they can do about the problem."

Water samples from the creek indicate bacteria counts that exceed federal standards, Covington said. The situation is aggravated, he added, during heavy rains that increase run-off into the water.

Noting the recreational nature of the creek and its tributaries, Covington said the possibility was good that a case of meningitis or typhoid would occur.

"I feel that the public needs to know about this. It's up to the public to put pressure on the authorities to do something about it."

Covington called on the state Health Department to ban the use of the streams for recreational use until pollution control measures are in place.

But Bruno Kirsch, director of engineering for the Health Department, said he was unaware of data that would substantiate the urgency of Covington's remarks.

He said he understood that sewer overflows, particularly during heavy rains, increased bacteria counts in the creek, but he said the problem should be alleviated with the completion of a new treatment plant under construction south of the Port of Little Rock.

> *'I feel that the public needs to know about this. It's up to the public to put pressure on the authorities to do something about it.'*
>
> *– Andy Covintgon*

Kirsch also said he was not sure the Health Department had the authority to prohibit residents from using the streams, although its jurisdiction did cover designated swimming holes and commercial recreational facilities.

"That might be stretching our authority," he said, "but I would need a legal opinion to be sure.

"People have individual rights, and they can go into that water if they want to."

Doug Szhener, information officer for the state Department of Pollution Control and Ecology, said, however, that the Health Department had the authority to quarantine streams for both recreational and water supply purposes.

Szhener said his department had become aware of the problem through a public hearing last August, but said it was his understanding that it would be largely alleviated with the completion of new sewer facilities.

Covington said sewer overflows and animal feces were thought to be the source of the problem.

Covington's remarks came as part of a progress report to the Metroplan Board of Directors on a three-year National Urban Runoff Project funded by the federal Environmental Protection Agency.

The $1 million demonstration project was designed to identify and alleviate sources of the creek's pollution.

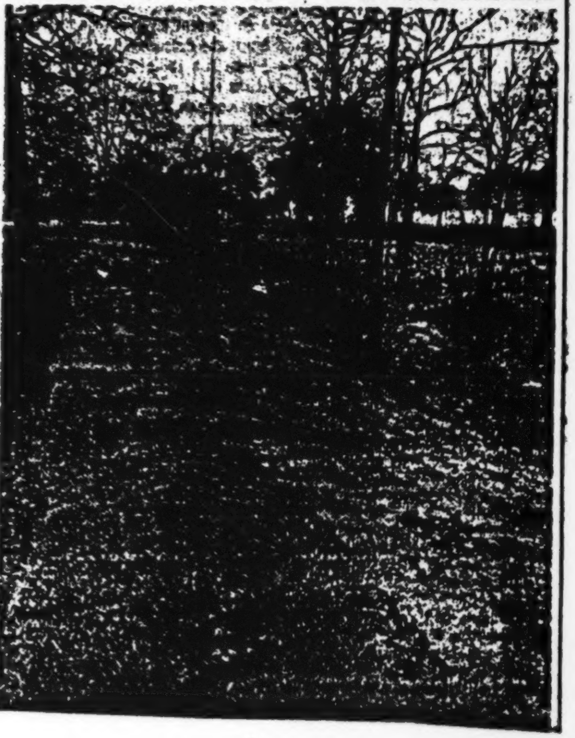
Covington said problems with sediment and metals had been identified and that the creek was relatively free of identified carcinogens.

The board agreed to enter a $10,000 contract with the Little Rock Parks and Recreation Department for materials used to control runoff into Coleman Creek in War Memorial Park. That work is part of the demonstration project.

ARKANSAS GAZETTE, Tuesday, February 16, 1982

—Staff Photos by W. L. (Pat) Patterson

Park Creek Is Getting A New Look



Coleman Creek's winding path through War Memorial Park has been going through some changes lately. The dam pictured above is one of six planned along the creek between West Markham Street and the Wilbur D. Mills Freeway as a means of reducing sediment buildup in the water. Sodding, like that shown at left, is being planted to help prevent erosion. Julius Breckling, director of the city's Parks and Recreation Department, said weeping willow and cypress trees also would be planted along the creek. ~~The city received a federal grant of about $20,000 to pay for supplies for the project~~ and city employes are doing the work. "It's a beautification project, and we're also trying to take care of some work with the creek that we've needed to deal with for a long time," Breckling said.

inaccurate

ARKANSAS DEMOCRAT 4/8/82

Signs to be posted at Fourche Creek

Signs will be posted soon in all Little Rock city parks traversed by Fourche Creek and its tributaries warning that the water is unsafe for swimming, drinking or wading.

Kim Woods, public information officer for Metroplan, said Wednesday that the intent was to keep residents, particularly children, away from the water because of dangerously high levels of fecal bacteria pollution.

SIGN:
LITTLE ROCK
FOURCHE
CREEK
URBAN
RUNOFF
PROJECT

COLEMAN
CREEK BMP
SITE

WAR•NING
THIS WATER UNSUITABLE FOR SWIMMING, DRINKING, AND WADING.
CITY OF LITTLE ROCK

People pay considerable attention to water problems when their property is damaged by floods or their crops are ruined by drought. But most of Arkansas's water problems are less obvious than weather-related disasters, and they develop gradually. The depletion of ground water or the contamination of rivers is not easy to detect until wells run dry or water becomes undrinkable. Such situations result not from natural events, but from human activities—and they may take centuries to correct. Our challenge is to identify the problems *before* they become critical and to change the unwise practices.

Most Arkansans enjoy the benefits of state-produced agricultural and manufactured goods, and we value quality outdoor recreation. If these are jeopardized by insufficient or impure water, then all of us will suffer. For years, the supply of clean water has far exceeded the demand. Now that is changing.

Arkansas still has plenty of water, much of it clean. But there are signs that our use of this essential resource is seriously affecting both its quantity and its quality. If current trends continue, some Arkansans will deplete their local supplies of water, and others will pollute the resource so badly that its treatment may be economically and technically impossible. The water crisis could be closer than we realize. This chapter will highlight the most pressing problems, all of them resulting from human actions, and all requiring human solutions.

Institutional Considerations

State water laws are inadequate to deal with legal conflicts over the resource. In the case of surface supplies, "riparian," or streamside, landowners have the right to use as much water as they reasonably need. But people who do *not* own property adjoining a stream may be denied access to its water; they have no right to its use.

A key problem is exactly what constitutes a "reasonable" use; for example, what if people unintentionally affect others' water supplies downstream? Under riparian law, there also is no incentive for conserving water; and even during droughts, state government plays a limited role in handling Arkansas's surface supplies. Though the General Assembly has empowered the state Soil and Water Conservation Commission to allocate surface water at times of shortages, this has never been done.

As ground-water supplies dwindle in eastern Arkansas, the state also lacks laws regulating *their* distribution. Ground-water rights, too, are based on the "reasonable-use" doctrine applied to all water under

PROJECT APPROVED

Metroplan's 3-year urban runoff project focusing on urban sectors of Fourche Creek has been approved by the U.S. Environmental Protection Agency, according to the agency's "Key Developments" newsletter.

The Fourche Creek project will be funded under EPA's Nationwide Urban Runoff Program and will receive money as soon as funds become available.

'GOALS' - PART 2

"Goals for Central Arkansas," a publication which resulted in 1973 from several hundred area residents expressing present and future area needs, was discussed in the December 1979 issue of the "Metroplanner."

Following is a continuation of how Metroplan, within its scope of planning and geographic limitations, has addressed some of the goals in part.

GOAL: Develop and encourage the use of mass transit facilities for the rapid and efficient movement of people and goods to and from, through and within the Central Arkansas area. RESPONSE: Central Arkansas Transit is expanding its services to new areas. Although North Little Rock has withdrawn from Central Arkansas Transit, a private transit system serves that city. New federal rural transportation programs will extend services to small communities and rural areas.

GOAL: Regional Roads that should be expedited are the East Belt Freeway, the North Belt Freeway, the South River Front Expressway and the North Little Rock River Front Drive. We should also initiate planning and seek approval for an outer loop to connect I-430 to the East and Northeast to U.S. 65 and I-40. RESPONSE: In compliance with the Pulaski Area Transportation Study, directed by Metroplan, the East Belt Freeway is under construction, and studies are underway for the North Belt Freeway and "outer loop."

GOAL: Encourage the use of more economical means of personal transportation than the private automobile, including walking, bicycles, and motorbikes to conserve fuel, reduce air pollution, reduce traffic congestion and to reduce land use in high-property-value areas for automobile parking. RESPONSE: The City of Little Rock has adopted a master bikeway plan. In addition, Metroplan, the City of Little Rock, Greater Little Rock Chamber of Commerce, Arkansas Department of Computer Services, Arkansas Department of Energy and Arkansas State Highway and Transportation Department have signed an agreement to conduct a pilot program for carpooling and vanpooling. The project is scheduled to begin in January with Metroplan providing a coordinator.

CALENDAR

January 30	Metroplan Board of Directors	1:30 p.m.

PLEASE POST OR CIRCULATE

METROPLAN
Continental Building—100 Main • Little Rock, Arkansas 72201

1/80

THE PREPARATION OF THIS REPORT WAS FINANCED IN PART THROUGH A COMPREHENSIVE PLANNING GRANT FROM THE DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT.

208 NEWS

WATER STUDIES FUNDED

Two Metroplan projects to improve water quality in Pulaski and Saline Counties have received funding for $950,000 from the U.S. Environmental Protection Agency.

Funding was granted for the Nationwide Urban Runoff Program for Fourche Creek in Little Rock with a total budget of $1,067,000 which includes $267,000 in contributions of local services. The 3-year project involves identification of Fourche Creek pollutants, development of control measures and evaluation of control measures.

Metroplan also received a $150,000 grant for continuing 208 Water Quality Management Planning projects, which include major studies of forestry activities along the Saline River and bauxite mining activities along Hurricane Creek in Saline County. Local contributions of $50,000 will supplement the grant.

The 208 program also includes an analysis of septic tank pollution near Little Rock and North Little Rock.

JACKSONVILLE ORDINANCE

The Jacksonville Sewer Commission has drafted an ordinance outlining sewer use requirements. The ordinance establishes regulations for installation and use of sewer lines.

Following review and approval by the Sewer Commission, the ordinance will be presented to the City Council for approval.

SLIDE SHOWS

If your organization would like a presentation on urban runoff or the Fourche Creek project, Metroplan has available 30-minute and 10-minute slide shows. Please contact the 208 staff to arrange for a presentation.

372-3300

CALENDAR

July 17	Transit Policy Board	10 a.m.
July 30	Metroplan Board of Directors	1:30 p.m.

Meetings are held in the Conference Room of the Continental Building

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METROPLAN
Continental Building—100 Main • Little Rock, Arkansas 72201

6/80

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MetroPlanner

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Nov.
1980

AIR QUALITY MEETING

Members attending the September meeting of the Air Quality Citizen Advisory Committee reviewed parking control measures and staggered work hours as examples of control measures to insure compliance with national ambient air quality standards.

The Committee concluded that parking controls in the downtown area of Little Rock should be applied only to "long term rates" (daily and monthly) in order not to have a negative impact on retail shopping. Employer programs to encourage the use of carpooling and transit vehicles were also discussed by the Committee.

Staggered work hours were discussed as a strategy to smooth traffic flow and improve transit vehicle efficiency.

METROPLAN ASSISTS CITIES

Metroplan is providing technical assistance to the cities of Benton, [illegible] and North Little Rock in the areas of property numbering and revision of subdivision regulations.

Benton requested Metroplan assistance in improving its property address system for future and existing neighborhoods. A committee formed to identify the address numbering problems cited duplication of house numbers and inconsistency in block numbers as major problems.

[illegible] is providing technical [illegible] Jacksonville and North [illegible]

NURP BEGINS

The Detailed Execution Plan for the Nationwide Urban Runoff Program, a 3-year project which focuses on urban sectors of Fourche Creek, has been approved by the Environmental Protection Agency.

The University of Arkansas at Little Rock is collecting water samples in the Fourche Creek and its tributaries to identify pollutants.

CONSTRUCTION WORKSHOP SPEAKER

[illegible] Clark, Arkansas attorney general, and Ken Obenauf, a staff engineer for the Georgia Soil and Water Conservation Committee, will speak at the Construction/Urban Runoff Workshop hosted by Metroplan October [illegible] from [illegible] a.m. to noon in the Continental Building Conference Room.

Clark will present his views on the importance of water quality and closer communication between state and local officials in formulating water management programs.

[illegible] will discuss [illegible] runoff.

[illegible] best management practices currently used in construction activity and to explore new programs to control construction runoff.

WASTE TREATMENT [illegible]

[illegible] Haskell and [illegible] receive [illegible] funding [illegible] Environmental Protection Agency under the 201 Construction Grants Program to build a regional sewage treatment plant.

(continued)

MetroPlanner

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Number 1
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Jan.
1981

W.O.B. RECOMMENDATIONS MADE

Metroplan recommended January 6 that the White Oak Bayou Task Force consider forming a sewer improvement district for the southern, more populous portion of the White Oak Bayou area and improve existing on-site systems with innovative and alternative methods in the northern part of the study area.

Jason Rouby, executive director of Metroplan, told the audience of approximately 100 persons at the EOA Building in Oak Grove that the Task Force had the responsibility to review Metroplan's recommendations.

The recommendations were made after preliminary sampling by the Arkansas Health Department in White Oak Bayou and Newton and Winifree Creeks indicated the presence of fecal coliform bacteria, an indication of leakage from septic tanks.

The Health Department will be asked to continue its sampling in the spring, when the warm wet ground conditions decrease the efficiency of septic tanks and promote the growth of bacteria. The sampling results would be reported to the Task Force, comprised of a Health Department official and six residents from the White Oak Bayou area.

Gary Rhodus, a member of the Task Force, suggested that sampling include well water in the area. "No one seems concerned that the streams along Highway 365 are polluted," he said, "but maybe they would be more concerned if they discovered their drinking water was contaminated."

Answering questions from the audience, Rouby stressed the value of dealing with the problem now. "We do not want anyone to catch typhoid in the future because of what we did not do today," he said.

The Task Force was formed with funding from the Environmental Protection Agency to study the septic tank problems in the White Oak Bayou area from September 1979 to January 1981. Metroplan will continue to coordinate the activities of the Task Force and the agencies as part of its continuing Water Quality Management Program.

SAMPLES SHOW POLLUTION LEVEL

Preliminary sampling of water from the Fourche Creek for the Nationwide Urban Runoff Program shows high levels of fecal coliforms probably caused by sewer overflows, said Warren Brainard, environmental planner at Metroplan. This supports findings of an earlier sampling program conducted by the University of Arkansas at Little Rock in 1976.

The sampling, under the direction of Dr. Richard Hanson of the Chemistry Department at the University of Arkansas at Little Rock, is being conducted as part of a 3-year federal NURP project. The project is funded by a $800,000 grant from the Environmental Protection Agency to evaluate pollutants in the Fourche Creek at Little Rock.

According to Brainard, early indications in parameters sampled may indicate high levels of heavy metals carried by urban stormwater runoff from parking lots and streets. In addition, preliminary findings show suspended solids to be a significant pollutant, resulting from construction activities.

Sampling reports, taken from nine sampling points in the Little Rock area, are expected to be released once a month. Sampling points are Rock Creek at West Markham, Grassy Flat at Reservoir Road, Coleman Creek at Asher Avenue, and Fourche Creek at University.

When the sampling is completed, Metroplan will implement and evaluate certain

(continued, pg. 3, col. 1.)

The Advisory Committee is composed of an equal number of representatives in the following categories: elected or appointed officials, public interest, special (economic) interest and private citizens.

Metroplan is conducting the utility's public participation program for the Adams Field environmental and facilities planning studies.

Comments made at the meeting will be considered by the Environmental Protection Agency and the utility for inclusion in the final EIS report.

SURVEY OPPOSES CLEARCUTTING

In a public opinion survey conducted by Metroplan and the Arkansas Forestry Commission, 76 per cent of the participants said clearcutting harmed state wildlife population.

The survey, directed by Jerry Donoho, environmental planner at Metroplan, and Jim Grant, information officer at the Forestry Commission, included 389 participants selected on a random basis for six days between September 29 and October 4 at the Forestry Commission Information booth at the Arkansas State Fair.

Donoho said 60 per cent of those polled agreed that forests protect the quality of Arkansas streams, 36 per cent felt the state should regulate clearcutting on state land, and 66 per cent said the best way to protect the environment was to ask the industries to comply voluntarily with recommendations.

In addition, 53 per cent said the costs of enforcing forest practice regulations should be sustained by the forest landowners, and 62 per cent said they had never heard of the Forestry Commission.

(continued from pg. 1.)

control measures for urban runoff and formulate a management plan to effectively deal with the problem, Brainard said.

One approach being investigated is the possible benefits of an expanded city parks system along Fourche Creek and its tributaries. Vegetation in parklands would slow the velocity of the runoff and trap sediments and other pollutants.

208 FACTS QUIZ

The following quiz will test your knowledge of the 208 Water Quaility Management Planning program. The answers are printed at the bottom of the page.

Mutltiple Choice (circle correct letter)

1. The 208 Program is: A) Local; B) National; C) State; D) All of the above
2. Which of these is not part of 208 plans? A) Point Source Management; B) Solid waste management; C) Financial Management; D) Nonpoint Source Management
3. Metroplan is responsible for the following 208 planning area: A) Arkansas; B) Little Rock; C) Pulaski/Saline Counties; D) Central Arkansas
4. The 208 plans cover a planning period of: A) 20 years; B) 10 years; C) 50 years; D) None of these
5. The most specific 208 plans addressing and managing water pollution are probably: A) National; B) Local; C) State; D) Regional
6. The Clean Water Act of 1977 which covers the Section 208 Program is due to be revised in: A) 1995; B) 2000; C) 1982; D) 1985

True-False (write "T" or "F")

7. The 208 Plan, once it is completed, cannot be changed. ____
8. The Little Rock Metropolitan 208 Plan emphasizes regulatory programs for nonpoint source problems. ____
9. Some of the most difficult decisions to be made in controlling water pollution are financial. ____
10. Citizen participation in the development of 208 plans is required by the federal government. ____

Multiple Choice		True-False
1. D	5. B	7. F
2. B	6. C	8. F
3. C		9. T
4. A		10. T

MetroPlanner

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1981

FOURCHE CREEK SAMPLING CONTINUES

Six months of wet and dry weather sampling of Little Rock's Fourche Creek and its tributaries has verified that beneficial uses of the Fourche may be impaired and that water quality criteria are not being met. Land-disturbing activities, runoff from paved surfaces and sewer overflows are the primary problems.

Metroplan's study of Fourche Creek is one of 30 demonstration projects funded by the U.S. Environmental Protection Agency under the Nationwide Urban Runoff Program (NURP) to evaluate and develop a control program for urban runoff.

EPA has determined that urban runoff constitutes the most serious nonpoint source pollution problem nationwide.

Mapping and the accumulation of related statistics for land characteristics have been compiled which will aid in the identification and assessment of problem areas. Control measures to prevent urban runoff pollution are being selected and will be incorporated into various city projects by the Little Rock Department of Public Works and the Department of Parks and Recreation.

Because control measures (or Best Management Practices) can only be evaluated in real-life construction situations, combinations of BMPs rather than specific BMPs will be the focus of the evaluation effort, said Warren Brainard, environmental planner at Metroplan.

"Exploring a number of control strategies for various land-disturbing activities which differ from site to site should give us a more practical framework for BMP evaluation rather than an isolated look at one particular BMP," said Brainard.

BMPs selected for evaluation represent those which can be most easily

(See SAMPLING, pg. 2, col. 1)

GROUNDWATER DATA COLLECTED

Metroplan, in cooperation with the Water Wells Commission and the Arkansas Geological Commission, has collected groundwater data for the Metropolitan Area. Data have been compiled on domestic, municipal and industrial water wells. In the 2-county area these wells have been mapped against a background of potential problem areas.

Located wells will be mapped against the background of identified problem areas such as landfills and industrial sites where spills and poor housekeeping may be causing groundwater contamination. Wells which have been identified and mapped in location of potential groundwater pollution will then be sampled and control methods will be evaluated.

This work is being done under a grant from the U.S. Environmental Protection Agency to evaluate groundwater resources in the Little Rock-North Little Rock Metropolitan Area.

The objectives of this program are:

1. To inventory waste disposal practices which have a potential for contaminating underground water
2. To evaluate the impact of waste disposal practices on underground water
3. To outline a control program

Work will be completed in 1981.

ANNUAL REPORT

Metroplan's 1980 Annual Report, a summary of the year's activities and achievements, is available without cost.

For a copy, please call Janet Roget Shults at 372-3300.

AIR QUALITY ALTERNATIVES SCREENED

The Pulaski Area Transportation Study Coordinating Committee has completed an analysis of automobile hydrocarbon emission reduction potential for a wide range of transportation-related control measures.

Staff members from Metroplan and the Arkansas State Highway and Transportation Department will meet with Policy Committee members to provide information about Pulaski County's air quality problem and the alternative remedies. Policy Committee members are encouraged to attend the Citizen Advisory Committee meetings May 7 to discuss the draft report on the transportation control measures prepared by Metroplan.

AIR QUALITY MEETING

An open meeting and workshop to review and discuss air quality issues and plans for Pulaski County will be held in two sessions on Thursday, May 7, 1981.

The afternoon session will begin at 2 p.m. in the Metroplan Conference Room, 100 Main Street, Little Rock. The principal topic of discussion will be the draft report on the Analysis of Alternative Transportation Control Measures prepared by Metroplan.

The evening session on the same topic will begin at 7 p.m. and will be held in the Arkansas Department of Pollution Control and Ecology Commission Room at 8001 National Drive, Little Rock.

The public is encouraged to attend either or both of the sessions.

SAMPLING
(continued from pg. 1)

evaluated from both a water quality and cost-effective standpoint and which are most likely to be used by the city in actual practice.

The Fourche and its tributaries drain more than 90 per cent of Little Rock and are associated with most of the Little Rock parks system.

WORKING FOR CLEAN WATER WORKSHOP

The Arkansas Science Information Exchange, in cooperation with Metroplan, will sponsor a Working for Clean Water in Arkansas workshop on May 19 from 9 a.m. to 3 p.m. at the University of Arkansas at Little Rock.

The workshop, funded by the U. S. Environmental Protection Agency, will focus on agricultural, silvicultural, and mining activities as sources of nonpoint pollution. Representatives of Metroplan's 208 Advisory Committee, the U. S. Department of Agriculture, Arkansas Department of Pollution Control and Ecology, local conservation districts and other agencies involved in 208 water quality management planning will discuss ways to coordinate public participation efforts relating to nonpoint source pollution.

ZONING AND SUBDIVISION WORKSHOP

A recent workshop on zoning and subdivision regulations was sponsored by Metroplan for Jacksonville, Sherwood, North Little Rock, Little Rock, and Pulaski County planning officials.

The workshop, conducted by Professor William S. Bonner and Robert K. Middleton of the Department of Community and Governmental Affairs, University of Arkansas at Fayetteville, was funded by the Arkansas Department of Local Services, Arkansas Municipal League, and the University.

The 1-day workshop included a review of the statutory requirements and procedures for municipal and county zoning, giving special attention to methods for modifying zoning requirements. Participants were also provided information on the application of subdivision regulations in the planning process, with specific regard to the review of sketch and preliminary plats.

Metroplan will sponsor this workshop on a demand basis.

The industry representatives present at the workshop favored a system of tax credits as opposed to other forms of tax relief. Tax credits were favored because they are easier to administer and, since a tax credit is an offset against net income, greater incentive is likely to result.

Currently, the costs of pollution control are passed on to the consumer at the maximum extent possible, creating a competitive disadvantage. For example, a representative of the home building industry stated that additional pollution control expenses could price homes out of the market. A well-designed tax incentive program could reduce disruptions in the market place which may result from the implementation of control measures.

Metroplan's study of financial incentives to encourage pollution control runoff measures will result in proposals submitted to the U.S. Environmental Protection Agency for consideration.

FOURCHE CREEK BMPs SELECTED

Metroplan, in cooperation with the Little Rock Departments of Public Works and Parks and Recreation, has selected suitable sites for the installation of Best Management Practices (BMPs) along the Fourche Creek tributaries of Rock Creek and Grassy Flat Creek. The BMPs will be installed to help reduce pollution from construction and urban runoff as part of the Little Rock Nationwide Urban Runoff Project (NURP).

(continued)

Metroplan's study of Fourche Creek is one of 30 demonstration projects funded by the U.S. Environmental Protection Agency to evaluate and develop a control program for urban runoff. Urban runoff has been determined by EPA to be the most serious of the nation's nonpoint pollution problems.

The cost of installing and maintaining these BMPs will be shared jointly by the city of Little Rock and Metroplan. In cooperation with the Little Rock Department of Parks and Recreation, Metroplan will provide $5,400 for the installation of sodding along Coleman Creek at War Memorial Park to prevent further erosion and $3,000 for bank stabilization and retention ponds at Rock Creek in Boyle Park. In addition, Metroplan will participate with the Little Rock Department of Public Works in providing $20,000 for Rock Creek at the Markham Parkway and $15,000 for Grassy Flat at Old Forge Road where grass seeding and rip-rap will be installed as a means to prevent erosion and encourage bank stabilization. These BMPs will stabilize disturbed areas along these streams and prevent further degradation of water quality.

Following installation, the BMPs will be evaluated to determine their effectiveness in improving water quality and their cost effectiveness.

CALENDAR

June 24	Metroplan Board of Directors	1:30 p.m.
June 25	Transit Policy Board - Public Hearing on CAT Fare Increases	10:00 a.m.

METROPLAN
Continental Building—100 Main • Little Rock, Arkansas 72201

5/81

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BMPS INSTALLED

The City of Little Rock has initiated a series of BMPs (Best Management Practices) in selected tributaries of Fourche Creek, in a secondary phase of Metroplan's national demonstration study of the Creek and ways to reduce and eventually eliminate its pollution.

BMP installation involving channel improvements in the vicinity of the West Markham Parkway and bank stabilization measures in War Memorial Park is underway. Water quality improvements resulting from the placement of these BMPs will be determined following an intensive sampling program to be conducted during the next several months.

A visit to Coleman Creek at War Memorial Park to view examples of these BMPs would be worthwhile. In addition to the expected improvements in the water quality, the beauty of the park has been enhanced.

(continued from front page)

problem areas for additional sampling. Cities and industries which are cooperating in the study include Shannon Hills, Little Rock, the Olin Corporation, AP&L, Exxon, Superwood, the Industrial Development Corporation, and Maybelline Company. Sampling of selected wells for possible groundwater contamination has begun and will include analyses for nitrates, organic compounds, hardness, and bacteria.

In addition to determining the chemical character of groundwater in the metropolitan area, Metroplan will develop a program for correcting potential or existing water quality problems discovered during the sampling phase of the project.

RIDESHARING

To encourage conservation and to promote Metroplan's Commuter Computer Match Service, Governor Frank White has designated September as RIDESHARE month.

All carpools are invited to register to win 100 gallons of gasoline. The prize is donated by Coulsen Oil Company. Listen to Craig O'Neill of KKYK for more details.

KIM WOODS PROMOTED

Kimberly Woods has been named Public Participation Coordinator for Metroplan's 208 Water Quality Management Program. She succeeds Janet Roget Shults, who has moved to Denver.

For the previous five years, Woods was the graphic designer for Metroplan. She received her drafting experience from Capital City Junior College and is continuing her education at the University of Arkansas at Little Rock.

CALENDAR

September 17	Transit Policy Board	10 a.m.
September 30	Metroplan Board of Directors	10 a.m.

METROPLAN
Continental Building—100 Main • Little Rock, Arkansas 72201

8/81

216

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METROPLAN COMPLETES WATER SAMPLING

The well water sampling program conducted by UALR under contract to Metroplan has been completed. The results of the sampling have been forwarded for review to the Environmental Protection Agency in Dallas, Texas and to the Arkansas Department of Pollution Control and Ecology and the Arkansas Department of Health.

The project funded by EPA under the Safe Drinking Water Act (SDWA) is intended to evaluate the quality of groundwater in Pulaski County. After a preliminary examination of sampling data, EPA has decided that the results warrant additional well sampling. The follow-up sampling program will be carried out by EPA and the State in coordination with Metroplan. It is expected that this second sampling program will permit Metroplan to define better the relationship between pollution sources and groundwater contamination.

Metroplan will complete the final report on this project by the end of October 1981. In addition to the sampling results, the final report will contain Metroplan's recommendations for protecting groundwater in the Metropolitan area.

CALENDAR

November 12	Adams Field Treatment Plant Improvement Study Public Hearing. Room 517B UALR Library	7:30 p.m.
November 19	Transit Policy Board	10:00 a.m.
November 25	Metroplan Board of Directors	10:00 a.m.

Metroplan's committees will meet in the ninth floor conference room of the Wallace Building.

Persons attending meetings at Metroplan should park on the lot north of Markham Street between Main and Scott Streets. A coupon will be issued by Metroplan to be placed in the payment box on the lot when leaving.

FURTHER PARK WORK RECOMMENDED

Following a tour of the Best Management Practices (BMPs) construction on [illegible] Creek at War Memorial Park, EPA's project officer, Ann Hartley, agreed with Metroplan's Water Quality staff to appropriate an additional $10,000 to the Little Rock Parks Department to extend the BMP installation. The funds will be used to construct additional retention basins and to do more bank stabilization and sodding south of the park bridge.

METROPLAN

Wallace Building, 105 Main Street, Little Rock, AR 72201

10/81

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1981

208 CAC ADOPTS RESOLUTION

At its quarterly meeting, the 208 Water Quality Citizen's Advisory Committee requested that Metroplan meet with the City Parks and Recreation Department and the City Board of Directors to develop a program to inform the public of the pollution in Fourche Creek and its tributaries. They also requested that the city post warning signs where necessary.

Water sampling results collected over several years have revealed high levels of bacteria (fecal coliform) pollution.

In addition to the Fourche Creek resolution, the advisory committee discussed future funding plans for continuing environmental planning at the regional level, and the status of several current planning projects.

Funding from EPA for the water pollution management planning conducted by Metroplan will expire at the end of April 1983. The planning staff is working with the advisory committee to develop a new program which will be funded through local sources. The new program will be broader in scope, integrating several environmental planning programs now conducted separately, and should result in improved efficiency.

The advisory committee discussed the recently completed Safe Drinking Water Program project through which groundwater quality in Pulaski and Saline Counties was evaluated. The results of the study generally indicate fair groundwater quality in the metropolitan area with some localized contamination beneath several wells. Correction programs for the affected wells will be proposed. In addition, the report outlining the results of the study recommends that the State of Arkansas adopt uniform groundwater quality standards for sources not now covered by public health regulations.

METROPLAN INVESTIGATES CNG FOR TRANSPORTATION FUEL

Metroplan recently held a meeting of local governmental agencies to consider using compressed natural gas as a transportation fuel. At the meeting, Charlie Fergus, a representative of a conversion company, explained why natural gas is better than gasoline or propane. He said it is cheaper (presently about 40¢ per gallon equivalent), it is an abundant domestic fuel, it should reduce vehicle maintenance costs about 37 per cent, and it is safer and cleaner burning.

Converting to natural gas involves adding pressure cylinders and a decompression valve before the gas enters the carburetor. The standard conversion to a passenger car will yield a 100 mile driving range and gasoline can serve as a standby fuel. The cost of conversion runs from $1,200 on a car to $1,600 for

Continued on back page

NEW OFFICERS ELECTED

The Metroplan Cooperative Purchasing Council met on December 16, 1981 and elected officers who will serve during fiscal year 1982. Jerry Paul, Purchasing Director for the City of Little Rock, will be Chairman, and Rebecca Cowling, purchasing Director for Pulaski County government will be vice-chairman.

The joint purchasing program began in January 1978 when thirteen (13) local member governments joined.

NEW MAILING ADDRESS

Metroplan
8th Floor, Wallace Building
105 Main Street
Little Rock, AR 72201
(501) 372-3300

MetroPlanner

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1982

CITY OF ALEXANDER RECEIVES TECHNICAL ASSISTANCE

Metroplan has delivered draft copies of a plan report and comprehensive plan and maps for the City of Alexander to the Alexander Planning Commission for its review.

After the Commission reviews the documents and recommends changes, if any, final copies of the reports and maps will be prepared and submitted to the Commission for formal adoption.

The preparation of a draft ordinance and subdivision regulations is underway.

Al Stafford, chairman of the Planning Commission, said the Commission was established in 1981 so Alexander could plan intelligently for the anticipated pressure on land development that is expected from the commercial and industrial development at the Otter Creek project at the Interchange of I-30 and I-430.

Major recommendations of the plan report are: 1. the incorporation of that part of Alexander in Saline County, platted in 1888 but never incorporated (the incorporation has been approved by the Circuit Court of Saline County;) 2. the extension of the Alexander planning area into Saline County, to include Alexander Mountain, an area along Shables Road and the area around the I-30 and I-430 interchange; 3. the provision of a municipal water supply in the planning area, and 4. the expansion of the Little Rock Sanitary system into the planning area.

In addition, efforts are underway to improve library services from the Central Arkansas Library System and to expand the Alexander Volunteer Fire Department.

Metroplan's technical assistance to Alexander is being supervised by Charles Randel, director of planning.

PUBLIC MEETING SCHEDULED FOR CLEAN LAKES PROJECT

A public meeting to discuss the details of the Lake Maumelle Clean Lakes Project will be held July 28, 1982 at 7:00 p.m., in the Reddy Kilowatt Room on the first floor of the Arkansas Power and Light Company, west Ninth and Louisiana Streets, Little Rock.

The National Clean Lakes Program is intended to help implement plans for restoring the quality of important water supply and recreation lakes. Questions raised during the development of the Little Rock 208 Water Quality Management Plan suggested that a comprehensive evaluation of Lake Maumelle, the major metropolitan water supply, would ensure that the lake retained superior water quality.

Continued

FOURCHE CREEK POSTING CAMPAIGN UNDERWAY

Metroplan is coordinating efforts to inform the public of the pollution problems in Fourche Creek and its tributaries. Warning signs will be placed in the parks along the urban creek system to advise the public of the need to avoid contact with contaminated water in the city.

In 1979, Metroplan received a grant from the Environmental Protection Agency to study the nature and extent of pollution in Fourche Creek. Data from the project have shown that all major tributaries to Fourche Creek are polluted. The EPA grant also provides funds for analyzing several Best Management Practices to select those effective in reducing pollution in the streams.

Continued

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1983

METROPLAN INFORMATION CENTER NEARS LIBRARY STATUS

Metroplan's collection of printed materials has, once again, begun to assume the appearance of a library. Katherine Stanick, a graduate librarian whose professional experience covers a variety of situations, undertook the reorganization on a part time basis about two years ago.

A specially devised classification system previously used had suffered from several moves of the Metroplan offices and from changes in supervisory personnel. It had been largely untended for some time. The current project, also, underwent the trauma of a move in the fall of 1981 when Metroplan was moved from space on the west side of Main Street to offices across the street. Items already classified and processed survived the transition and some materials roughly sorted by subject were set aside for future consideration. The inconvenience and disruption of the move were partly off-set by some improvement in physical arrangements.

The collection contains about five hundred bound monographs and two to three thousand other individual items including journals, pamphlets and ephemera. Items published by government agencies at all levels, associations, business and professional organizations, private entities and individual authors are included. Some publications are from foreign countries. Some items in the collection are of historic interest; many others are of current date.

The Dewey decimal system of classification was chosen after some preliminary study because of its familiarity to many users and its adaptability to the needs of this collection. Subject headings

(Continued on back page)

COMMITTEES REVIEW WATER STUDIES

The Water Quality Management Citizens Advisory Committee agreed December 8 to recommend urban runoff control measures from the Fourche Creek Urban Runoff Project (NURP) to the Little Rock City Board of Directors for its consideration. The Committee hopes these recommendations will encourage additional effort by the city to reduce urban runoff problems.

Richard Magee, senior planner for Metroplan, described to the Committee the process of locating and identifying land uses in the Lake Maumelle watershed, one of the early work items in the Lake Maumelle Clean Lakes Project. The accumulated land use information was digitized and stored on tape, using a computer program written by Senior Planner John Barr specifically for the Clean Lakes Project. The final result was a computerized map of the entire watershed with land use clearly defined. With the land use analysis complete, all that remains to be done is encoding sub-basins, and soils and slopes data for the watershed, Magee said.

The results of the last eight months of water samples taken from Lake Maumelle show that the water quality and clarity is good. The

(Continued on back page)

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METROPLAN a council of local governments

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Dr. Grant Shockley, president of Philander Smith College, asked the invocation at Metroplan's 28th Annual Meeting January 21, 1983. The text of Dr. Shockley's prayer follows:

Almighty God, in whose sight a thousand years are but as yesterday when it is past and as a watch in the night;

In whom and by whom all things live; in whom alone dwells light; whose throne is truth and whose scepter is rightousness; hear us, oh blessed Thee.

We thank you for life, for liberty and for the freedom to pursue happiness in this our nation of free persons.

We thank you for the efforts of all who have gone before us in the community; gathered here in dreaming, planning and working for a safer environment.

Correct our judgements when they err; cleanse our motives when they are not pure; inform our opinions when they are in ignorance that together we may raise up for our children cities beautiful; cities bountiful and cities beloved.

Bless now, O Lord, these physical tokens of your grace that spread before us.

As we partake of them, may our bodies be strengthened to do your work;

Our minds renewed to think your thoughts;

Our spirits refreshed to follow your will for your sake and the sake of futures yet to be.

Amen.

CHANCELLOR YOUNG PRAISES UALR – METROPLAN PROJECTS

The University of Arkansas at Little Rock shares with Metroplan a commitment to public service and the practical application of quality research, Chancellor James Young told the 150 persons at Metroplan's 28th annual meeting.

Dr. Young was the guest speaker at the dinner meeting, attended by members of the Metroplan Council and Board of Directors, state legislators and elected and appointed office holders representing Metoplan's 22 member governments.

Calling for quality education, Dr. Young emphasized that equality of human worth and equality of opportunity were compatible with excellence in education and achievement.

He praised the many projects in which UALR and Metroplan have cooperated, particularly in the area of water quality management and promised to encourage similar cooperative efforts in the future.

Dr. Young, in his first year at UALR, was accompanied by his wife Jacqueline.

1982 ENVIRONMENTAL AWARDS PRESENTED AT ANNUAL MEETING

Some of the highlights of Metroplan's annual banquet were the presentation of the 1982 Environmental Service Awards.

The 1982 Environmental Service Awards were presented for outstanding contributions to the preservation, restoration, and protection of the environmental quality of the Little Rock-North Little Rock Metropolitan Area, and for leadership and initiative to involve others in service to the community. A corporate, government, and private individual received recognition for this service.

Robert D. Hornbeck, of Pittsburg, Pennsylvania, Executive Vice-President of the Aluminum Company of America (ALCOA),

(Continued)

accepted the award in the corporate individual category for directing Arkansas Operations of Aloca to restore all mined bauxite lands to a crop-sustaining state, including acreages which state and federal laws make exempt from recovery. Projected costs of recovery over 10 years is more than $10,000,000.

Julius Breckling, director of Parks and Recreation for the City of Little Rock, received the award in the government individual category. Mr. Breckling was commended for his work with the experimental landscaping techniques designed to control pollution in the city parks, including check dams along the creeks and grassing slopes to reduce erosion. In addition, Mr. Breckling has made major efforts to continue the acquisition of park lands along major streams, and has played a major role in making users aware of the park pollution problem.

Sharon Priest of Southwest Little Rock received the award in the private individual category. Mrs. Priest was instrumental in initiating action which led to the Little Rock Board of Directors approving preparation of an excavation control ordinance by the City staff. She also initiated and directed a petition project to gain support for the U.S. Corps of Engineers Fourche Creek Flood Control Plan.

From left....

Robert D. Hornbeck, Julius Breckling, and Sharon Priest

CALENDAR

March 17	Transit Policy Board Meeting . . . 10 a.m.
March 30	Metroplan Board of Directors . . . 10 a.m.

Paid parking is available on the lot north of Markham between Main and Scott Streets, or on the third floor parking deck of the Trailways Bus Station.

METROPLAN
800 WALLACE BUILDING • 105 MAIN STREET
LITTLE ROCK, ARKANSAS 72201

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LITTLE ROCK BENEFITS FROM WATER QUALITY PLANNING

Metroplan's Fourche Creek Urban Runoff Project substantially improved the water quality of area streams, an engineering consultant reported recently in a meeting with officials of the U.S. Environmental Protection Agency in Washington.

The Fourche Creek 5-year study was selected by EPA from 30 projects nationwide to be highlighted in a report to Congress.

Little Rock's Parks and Recreation and Public Works Departments cooperating with Metroplan, installed erosion control measures along three tributaries of the Fourche Creek system.

Stabilized slopes, grassing, sod, dams and retention basins reduced the pollution loadings entering Coleman Creek at War Memorial Park by as much as 40 per cent.

On Rock Creek between Markham and Shackleford Roads, banks were cleared and flattened, and riprap and vegatation were added. Water samples taken before and after heavy rains showed a 24 per cent reduction in suspended solids and a 34 per cent reduction in phosphorus contamination.

Along Grassy Flat Creek on Rodney Parham Road, gabions (wire cages filled with stone) were added to prevent further erosion of the stream bank. After these improvements were installed, the natural shale bottom of the stream reappeared.

Metroplan provided funding for these projects to the City of Little Rock.

Due to the success of these erosion control projects, recommendations will be made to cities to incorporate these and other similar projects in future drainage projects. A final report on the water sampling results, findings, and recommendations will be delivered to EPA June 15, 1983.

LAKE MAUMELLE GETS TOP RATING IN WATER QUALITY

The water quality of Lake Maumelle is good, and as a municipal water source, Lake Maumelle is excellent.

Dr. Carl Stapleton, associate professor of biology at the University of Arkansas at Little Rock, reported those findings at a public meeting April 7. The meeting was sponsored by Metroplan, UALR and the Arkansas Department of Pollution Control and Ecology for the Lake Maumelle Clean Lakes Study.

Dr. Stapleton, under contract from the Arkansas Department of Pollution Control and Ecology is conducting a technical review of the Lake to assess current pollution loadings. The water sampling results taken during the last year and from nine locations in the Lake show that levels of bacteria, phosphorus, BOD, and chlorophyll 'a', some of the parameters being tested, were well within the limits set for a Class AA surface water supply.

Richard Magee, senior planner with Metroplan, has completed a land use, soils, and slopes analysis for the watershed. The results show that the land surrounding the Lake has severe potential for erosion. Development practices which occur should incorporate erosion and sediment control measures, Magee suggested.

Future analysis of the Lake bottom may result in recommendations for increasing the flow of water through the system, Andy Covington of Metroplan said. Since the water remains in the Lake from 1.72 to 7.5 years depending on water use demand and environmental conditions, pollutants may be accumulating in the bottom of the Lake.

The object of the study is to learn about Lake Maumelle's condition in order to preserve its water quality. To insure this, future recommendations may include proposing development and land use practices in the Lake's watershed.

CAT APPLIES FOR GRANT

Metroplan and Central Arkansas Transit (CAT) have prepared a program of transit improvement projects under the provisions of the recently enacted Federal Public Transit Act of 1982. The grant application will be filed under the UMTA Section 9A procedures. Major items to be purchased with the grant funds include a bus washer, new fare boxes and a small computer system to be used for vehicle maintenance records, accounting and word processing. The grant funds will also be used to purchase land for the long needed new maintenance facility for CAT, and for the preparation of design plans for the facility.

UNIFIED WORK PROGRAM DRAFTED

The Pulaski Area Transportation Study (PATS) has completed a draft work program for FY 1984 transportation planning activities. The recommended work program includes a review of the priority improvement projects shown in the revised PATS Transportation Plan. The new list of priority improvements resulting from this study will be submitted to the PATS Policy Committee for its consideration.

COMPUTER USER GROUP MEETS

Microcomputer supervisors from several local governments met in late April at the first meeting of a computer use group sponsored by Metroplan.

Persons attending or expressing interest in participating in future meetings included Mayor James Reid of Jacksonville and staff persons from Little Rock, North Little Rock, Pulaski County, IREC, AIDC, and the Arkansas Highway and Transportation Department.

The purpose of the computer user group is to expedite the exchange of computer-stored information between members of the group and between them and other units of local, state and federal offices; to assist local governments in their acquisition and use of microcomputers, and to improve the competency of microcomputer users.

The group asked the staff of Metroplan, as a first step, to prepare a questionnaire that could be sent to all members of Metroplan so that an inventory of microcomputers, programs and qualified personnel could be compiled.

PLEASE POST OR CIRCULATE

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